

**BUREAU OF HIGHWAYS  
REQUEST FOR PROPOSAL  
for  
Qualification Based/Low Bid Services  
Revised 8/18/11**

The Michigan Department of Transportation (MDOT) is seeking professional services for the project contained in the attached scope of services.

If your firm is interested in providing services, please indicate your interest by submitting a proposal. The proposal must be submitted in accordance with the format and process outlined in the latest "Vendor Selection Guidelines for Service Contracts", available on the MDOT website. Follow the page limitations listed for Tier III services. The vendor must provide ~~ten (10)~~ **fourteen (14)** paper copies of the proposal to the MDOT project manager named in the attached scope of services. These copies must be received by the project manager by **Friday, September 2, 2011, 3 PM**. Fax and electronic copies are not acceptable. One unbound copy of the proposal must also be submitted to Contract Services Division at the address listed below.

Regular Mail:

Secretary, Contract Services Division  
Michigan Department of Transportation  
P.O. Box 30050  
Lansing, MI 48909

OR

Overnight Mail:

Secretary, Contract Services Division  
Michigan Department of Transportation  
425 W. Ottawa  
Lansing, MI 48933

Any questions relative to the scope of services must be submitted by e-mail to the MDOT project manager. Any questions must be asked at least five working days prior to the proposal due date and time specified above. All questions and answers will be placed on the MDOT website as soon as possible after receipt of the questions. The names of vendors submitting questions will not be disclosed.

The selection team will review the proposal submitted to determine a short list of qualified vendors. Vendors on the short list will be invited to submit ~~technical proposals~~ **and** bid sheets, and to participate in an on-site demonstration to collect specified condition data. On-site demonstrations collecting roadway data and an oral presentation displaying your company's services, software packages, and results from the demonstration collection will be conducted. MDOT will furnish information concerning specific dates, demonstration route, and evaluation criteria upon invitation for product demonstration. The demonstration route will be in the Lansing area and will be less than 10 miles long. The on-site demonstration and oral presentation are a requirement. Any

vendor that does not meet the requirements of the on-site demonstration will be eliminated from further consideration. Expenses incurred for the on-site demonstration are the responsibility of the vendor, there will be no compensation from MDOT. In addition, the short listed vendors will be required to deliver to MDOT an advance demo copy of their software within approximately one week of notification of short listing. Due dates will be specified at time of short listing. This advance demo does not need to display data for the demonstration route, but is intended to allow some user investigation of the software in preparation for the oral presentation and, therefore, is to be a fully functional version.

Only bids of short listed vendors that meet qualification requirements based on proposals and the presentation/demonstration will be opened. MDOT will post the date of the bid opening on the MDOT website. Only bids from vendors that meet proposal requirements will be opened. The vendor with the lowest bid will be selected. The selected vendor may be contacted to confirm capacity.

### **Scoring Criteria**

<b>Understanding of Service</b>	<b>Total Points Possible = 30</b>
<b>Qualifications of Team</b>	<b>Total Points Possible = 40</b>
1. Organization of Team	Total Points Possible = 15
2. Qualifications of Team Leader	Total Points Possible = 15
3. Qualifications of Remaining Key Staff	Total Points Possible = 10
4.	
<b>Past Performance</b>	<b>Total Points Possible = 25</b>
<b>QA/QC Process</b>	<b>Total Points Possible = 20</b>
<b>Location</b>	<b>Total Points Possible = 5</b>
	<b>Total: 120 Points</b>

Vendors meeting 75 points out of 120 will make the short list. Vendors on the short list will be invited to submit technical proposals and bid sheets, and to participate in an on-site demonstration to collect specified condition data. Again, any vendor that does not meet the requirements of the on-site demonstration will be eliminated from further consideration. Presentation scoring will be as follows:

<b>Presentation – Collection &amp; Presentation of Data</b>	<b>Total Points Possible = 25</b>
<b>Presentation – Software</b>	<b>Total Points Possible = 20</b>
<b>Presentation – Collection Equipment &amp; Process</b>	<b>Total Points Possible = 10</b>
<b>Presentation – Additional Items</b>	<b>Total Points Possible = 5</b>
	<b>Total: 60 Points</b>

Bids will be opened for all short listed Vendors meeting 45 points out of 60, and the vendor with the lowest bid shall be selected.

The scope of services is *attached* to this solicitation.

## CHECKLIST TO DESIGNATE AREAS OF EVALUATION FOR REQUESTS FOR PROPOSAL (RFP)

MDOT PROJECT MANAGER			JOB NUMBER (JN)	CONTROL SECTION (CS)
DESCRIPTION				
<b>MDOT PROJECT MANAGER:</b> Check all items to be included in RFP  WHITE = REQUIRED GRAY SHADING = OPTIONAL			<b>CONSULTANT:</b> Provide only checked items below in proposal	
Check the appropriate Tier in the box below				
<b>TIER I (\$25,000-\$99,999)</b>	<b>TIER II (\$100,000-\$250,000)</b>	<b>TIER III (&gt;\$250,000)</b>		
			Understanding of Service	
			<i>Innovations</i>	
			<i>Safety Program</i>	
N/A			Organizational Chart	
			Qualifications of Team	
			Past Performance	
Not required As part of Official RFP	Not required As part of Official RFP		Quality Assurance/Quality Control	
			<b>Location:</b> The percentage of work performed in Michigan will be used for all selections unless the project is for on-site inspection or survey activities, then location should be scored using the distance from the consultant office to the on-site inspection or survey activity.	
N/A	N/A		Presentation	
N/A	N/A		Technical Proposal (if Presentation is required)	
3 pages (MDOT Forms not counted) <b>(No Resumes)</b>	7 pages (MDOT Forms not counted)	19 pages (MDOT Forms not counted)	<b>Total maximum pages for RFP not including key personnel resumes</b>	

# REQUEST FOR PROPOSAL

The Michigan Department of Transportation (MDOT) is seeking professional services for the project contained in the attached scope of services.

If your firm is interested in providing services, please indicate your interest by submitting a Proposal, Proposal/Bid Sheet or Bid Sheet as indicated below. The documents must be submitted in accordance with the latest "Consultant/Vendor Selection Guidelines for Service Contracts" and "Guideline for Completing a Low Bid Sheet(s)", if a low bid is involved as part of the selection process. **Referenced Guidelines are available on MDOT's website under Doing Business > Vendor/Consultant Services > Vendor/Consultant Selections.**

## RFP SPECIFIC INFORMATION

BUREAU OF HIGHWAYS		BUREAU OF TRANSPORTATION PLANNING **		OTHER
THE SERVICE WAS POSTED ON THE ANTICIPATED QUARTERLY REQUESTS FOR PROPOSALS				
NO	YES	DATED _____	THROUGH _____	
<b>Prequalified Services</b> – See page ____ of the attached Scope of Services for required Prequalification Classifications.		<b>Non-Prequalified Services</b> - If selected, the vendor must make sure that current financial information, including labor rates, overhead computations, and financial statements, if overhead is not audited, is on file with MDOT's Office of Commission Audits. This information must be on file for the prime vendor and all sub vendors so that the contract will not be delayed. <b>(Form 5100J Required with Proposal)</b>		

**Qualifications Based Selection** – Use Consultant/Vendor Selection Guidelines

**For all Qualifications Based Selections**, the section team will review the information submitted and will select the firm considered most qualified to perform the services based on the proposals. The selected vendor will be contacted to confirm capacity. Upon confirmation, that firm will be asked to prepare a priced proposal. Negotiations will be conducted with the firm selected.

**\*\*For RFP's that originate in Bureau of Transportation Planning only**, a priced proposal must be submitted at the same time as, but separate from, the proposal. Submit directly to the Contract Administrator/Selection Specialist, Bureau of Transportation Planning (see address list, page 2). The priced proposal must be submitted in a sealed envelope, clearly marked "**PRICE PROPOSAL.**" The vendor's name and return address **MUST** be on the front of the envelope. The priced proposal will only be opened for the highest scoring proposal. Unopened priced proposals will be returned to the unselected vendor(s). Failure to comply with this procedure may result in your priced proposal being opened erroneously by the mail room.

**For a cost plus fixed fee contract**, the selected vendor must have a cost accounting system to support a cost plus fixed fee contract. This type of system has a job-order cost accounting system for the recording and accumulation of costs incurred under its contracts. Each project is assigned a job number so that costs may be segregated and accumulated in the vendor's job-order accounting system.

**Qualifications Review / Low Bid** - Use Consultant/Vendor Selection Guidelines. See Bid Sheet Instructions for additional information.

For Qualification Review/Low Bid selections, the selection team will review the proposals submitted and post the date of the bid opening on the MDOT website. The notification will be posted at least two business days prior to the bid opening. Only bids from vendors that meet proposal requirements will be opened. The vendor with the lowest bid will be selected. The selected vendor may be contacted to confirm capacity.

**Best Value** - Use Consultant/Vendor Selection Guidelines. See Bid Sheet Instructions below for additional information. The bid amount is a component of the total proposal score, not the determining factor of the selection.

**Low Bid** (no qualifications review required - no proposal required.) See Bid Sheet Instructions below for additional instructions.

## BID SHEET INSTRUCTIONS

A bid sheet(s) must be submitted in accordance with the "Guideline for Completing a Low Bid Sheet(s)" (available on MDOT's website). The Bid Sheet(s) is located at the end of the Scope of Services. Submit bid sheet(s) separate from the proposal, to the address indicated below. The bid sheet(s) must be submitted in a sealed manila envelope, clearly marked "**SEALED BID.**" The vendor's name and return address **MUST** be on the front of the envelope. Failure to comply with this procedure may result in your bid being opened erroneously by the mail room and the bid being rejected from consideration.

**PROPOSAL SUBMITTAL INFORMATION**

REQUIRED NUMBER OF COPIES FOR PROJECT MANAGER	PROPOSAL/BID DUE DATE	TIME DUE
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**PROPOSAL AND BID SHEET MAILING ADDRESSES**

Mail the multiple proposal bundle to the MDOT Project Manager or Other indicated below.

MDOT Project Manager

MDOT Other

Mail one additional stapled copy of the proposal to the Lansing Office indicated below.

<b>Lansing Regular Mail</b>	<b>OR</b>	<b>Lansing Overnight Mail</b>
Secretary, Contract Services Div - B470 Michigan Department of Transportation PO Box 30050 Lansing, MI 48909		Secretary, Contract Services Div - B470 Michigan Department of Transportation 425 W. Ottawa Lansing, MI 48933
Contract Administrator/Selection Specialist Bureau of Transportation Planning B470 Michigan Department of Transportation PO Box 30050 Lansing, MI 48909		Contract Administrator/Selection Specialist Bureau of Transportation Planning B470 Michigan Department of Transportation 425 W. Ottawa Lansing, MI 48933

**GENERAL INFORMATION**

Any questions relative to the scope of services must be submitted by e-mail to the MDOT Project Manager. Questions must be received by the Project Manager at least four (4) working days prior to the due date and time specified above. All questions and answers will be placed on the MDOT website as soon as possible after receipt of the questions, and at least three (3) days prior to the RFP due date deadline. The names of vendors submitting questions will not be disclosed.

MDOT is an equal opportunity employer and MDOT DBE firms are encouraged to apply. The participating DBE firm, as currently certified by MDOT's Office of Equal Opportunity, shall be listed in the Proposal

**MDOT FORMS REQUIRED AS PART OF PROPOSAL SUBMISSION**

**5100D** – Request for Proposal Cover Sheet

**5100J** - Consultant Data and Signature Sheet (Required only for Non-Prequalified Work)

**(These forms are not included in the proposal maximum page count.)**

## SCOPE OF WORK

For

Pavement Condition Data/Right-of-Way Image Collection and Processing  
**Years 2012 - 2015**

Issued by:

STATE OF MICHIGAN  
DEPARTMENT OF TRANSPORTATION  
Construction & Technology Division  
Bureau of Highway Delivery  
**July, 2011**

For further information regarding this scope contact:

Project Manager  
Daniel J. Sokolnicki, P.E.  
Michigan Department of Transportation  
8885 Ricks Road  
P.O. Box 30049  
Lansing, MI 48909  
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## **1. GENERAL INFORMATION**

### **A. Introduction**

The State of Michigan, as represented by Michigan Department of Transportation (MDOT), intends to use this Scope of Work to provide the Service Vendor (Vendor) with information to enable them to prepare and submit a proposal for pavement surface condition data & roadway imaging collection during the four-year period of 2012 through 2015, inclusive - encompassing two 2-year MDOT collection/processing cycles. The Vendor's proposal must include a plan for accomplishing the collection, processing, reporting, and delivery of data in compliance with the required specifications and procedures defined in this document and clarified by the MDOT Project Manager, or his representative, as needed. All necessary hardware and software must be supplied by the Vendor.

### **B. Scope**

Data items to be collected and processed include continuous roadway digital imaging (synchronized forward-facing perspective, rear-facing perspective, and pavement downview), surface distress survey (type/severity/extent identification), transverse/longitudinal pavement profile measurements (International Roughness Index, wheelpath rut, crack/joint fault), GPS coordinates, and grade/curvature measurements. Surface distress survey data services shall include identifying distress patterns in a separate file for each MDOT-defined pavement segment in compliance with specifications and procedures defined in this document. All pavement condition information for each specified pavement segment shall be collected in one continuous pass at posted highway speeds, not to exceed 65 mph.

The Vendor shall provide access to, and maintenance of, all hardware and software needed to associate pavement condition data with collected roadway/pavement images. Backups of all collected/processed data shall also be provided by the Vendor.

### **C. Objectives/Needs**

Collect, process, and report seven general categories of data including:

- \*Digital imaging of forward perspective view, rear-facing perspective view, and pavement downview.
- \*Surface distress type/severity/extent identification and processing.
- \*Longitudinal profile measurement (to calculate IRI).
- \*Transverse profile measurement (to calculate wheelpath rut).
- \*Faulting detection/measurement.
- \* Grade & curvature measurement.
- \*Global Positioning System (GPS) Coordinates.

The relationships among the above seven categories of data must be designed by the

Vendor according to relational database principles. For an example, a data set (record) of each data category shall contain unique referencing data values which are also in the corresponding data set (record) of the other data categories. This provides a means to properly associate a data set (record) in one category with its corresponding data set (record) in any other data category.

All software and hardware required to meet the specifications outlined in this document shall be supplied by the Vendor. The Vendor shall provide all maintenance and support. The Vendor shall provide the necessary training to operate and troubleshoot any software. All software and licenses necessary to view, reduce, and analyze data shall be included in the contract prices associated with software and hardware. Upgrades to the software shall be provided to MDOT, at no charge to MDOT. Any software licensing rights granted to MDOT shall include all potential users deemed necessary by MDOT to achieve the business objectives of MDOT. The users to be granted licensing rights shall include, but not be limited to, the following groups located at any MDOT location at any time during the contract:

- All MDOT permanent employees
- All MDOT interns and temporary employees
- All MDOT vendors
- All MDOT partners
- Any other group/individual necessary to achieve MDOT's business objectives.

Any group or individual not granted rights to use the software under this contract will be directed by MDOT to purchase a legal copy and/or licensing rights from the Vendor.

The Vendor shall provide comprehensive, readable user-manual and technical-training documentation for the entire system, software/hardware, and any updates.

All deliverables within this contract shall be covered by a warranty. This warranty shall begin on the day the first deliverable is received by MDOT and shall conclude three (3) years after the end of the contract.

Any upgrades to the system within the warranty period shall be performed at the Vendor's expense. Hardware and software shall be, and shall remain, compliant with the Michigan Department of Technology, Management, and Budget operating system standards. The applicable technical policies and procedures can be found at

<http://www.michigan.gov/dmb/0,1607,7-150-56355---,00.html>

All software, hardware and data shall continue to run despite any changes in the MDOT standard (an operating system change, for example). Malfunctions or failures reported to the Vendor shall be corrected within one week from the time of notification by the MDOT Project Manager. A penalty of \$5,000 per each full week late will be imposed for delayed correction.

Data submitted for weekly MDOT quality assurance purposes shall be via external storage device with USB interface or FTP upload. Final data submissions shall be via FTP upload.

In addition, the Vendor shall have the capability of providing backup copies of all collected/processed data at the same quality level as that of the originally submitted data for a period of seven years after the contract expiration date.

**D. Basic Description of MDOT's Intended Pavement Condition Data Collection**

For the 2012-2015 collection period, MDOT has approximately 37,925 miles of network data collection to be performed. Typically, data are to be collected/measured on both directions of divided highways (mainly freeways and boulevards) and on a single, MDOT-specified direction of non-divided highways. The following table contains total collection mileage estimates for each of the four contract years:

<b>Yearly Mileage Estimates</b>				
<b>Route Classification</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>
State Trunk - I & US	3,554	5,547	3,554	5,547
State Trunk - M (Michigan)	5,919	1,742	5,919	1,742
Non-Trunk/NHS	350	350	377	350
Non-Trunk/Non-NHS	1,002	986	0	986
<b>Total</b>	<b>10,825</b>	<b>8,625</b>	<b>9,850</b>	<b>8,625</b>

Collection mileage estimates per data type are outlined in ATTACHMENT D: VENDOR PAY ITEM BID SHEET (2012-2015). MDOT will annually provide the Vendor with a TapeLog file and supporting files defining the specific segments to be collected and the specific data types required for each location.

Downview imaging, surface distress surveying, and longitudinal profile measuring are to be continuous along the entire mileage for each specified pavement segment (i.e. no sampling), with the exception of Surface Distress Survey Data Option F2 – a network sampling approach - as defined in Section B.2.2. and ATTACHMENTS E and F.

Surface distress surveying shall include identifying Principle Distress type, and length/width/type of Associated Distress (additional cracking, missing pavement, etc.). The surface distress locations shall be recorded to the nearest 0.001 mile and referenced to MDOT's linear referencing system mileposts within each defined pavement segment.

Transverse and longitudinal profile measurements are to be obtained and processed by the Vendor using a Class 1 Inertial Profile instrument (ASTM E-950) in compliance with

applicable AASHTO standards (listed in ATTACHMENT B - APPLICABLE AASHTO STANDARD SPECIFICATIONS). Raw profiles are to be delivered to MDOT along with reduced 0.1-mile summary data reports. The Vendor shall supply software to convert transverse profile measurements into average rut depth data for each wheelpath, processed at any interval, but normally 10 feet, 50 feet, and 0.1-mile. The Vendor's software shall also calculate IRI (International Ride Index) in English units from collected longitudinal profile measurements, and have functionality to vary the pavement length reporting interval (but most frequently 0.1-mile).

## **2. DETAILED INFORMATION**

### **A. COLLECTION**

#### **1. Description**

A.1.1. The Vendor shall collect, process, and deliver pavement surface distress survey data, images (pavement down view, right-of-way perspective view, rear-facing perspective view), longitudinal profile (raw version and IRI), transverse profile (Rut), crack/joint fault, grade & curvature, and GPS data. Data types and associated annual mileage estimates are outlined in ATTACHMENT D: VENDOR PAY ITEM BID SHEET (2012-2015).

A.1.2. The Vendor shall submit, in accordance with applicable MDOT Vendor solicitation guidelines, a price bid to annually collect, within the time frames outlined in Section A.2.1., data for the specified network locations.

A.1.3. The Vendor's vehicle shall contain Geographic Information System (GIS) navigation capability that allows pre-collection loading of MDOT network segmenting location data defined in terms of Geographic Positioning System (GPS) coordinates extracted from MDOT's GIS environment.

#### **2. Collection, Deliverable Time Frames and Associated Penalties**

A.2.1. For each year's roadway itinerary, collection shall not commence prior to April 1, and shall be completed within 15 weeks from that date in Year 2012; within 12 weeks from that date in 2013; within 11 weeks from that date in 2014; within 12 weeks from that date in 2015. In no case shall work commence prior to the contract execution date. The Vendor shall be subject to a \$5,000 penalty per each full week beyond the above-defined timeframe that a given year's collection is actually completed. Granting of extensions due to delays reasonably beyond the Vendor's control (bad-weather days, as example, but not equipment failures) will be considered by MDOT upon review of the Vendor's explanation.

A.2.2. The Vendor shall organize and submit all processed data by Region boundaries (defined by MDOT) as completed. As outlined in ATTACHMENT C – 2012-2015 COLLECTION & DELIVERY SCHEDULE, processed full-Region surface distress survey data submittals (seven total) shall occur on a four-week interval for Surface Distress Survey Data Option F1\* (two-week interval for Surface Distress Survey Data Option F2\*) starting no later than eight weeks after the collection start date for Option F1\* (six weeks for Option F2\*)– with the exception of the last full-Region submittal for Option F2\*, which may occur up to 3 weeks after the previous (sixth) submittal, but no later than 19 weeks after the collection start date.) The Region order of submittals shall match the order of that season's collection, as defined by MDOT during the annual kick-off meeting. As creation of distress survey data is contingent upon successful collection of pavement images, granting of extensions to these defined data delivery schedules - in line with any extensions granted for collection completion (Section A.2.1.) - will be considered by MDOT.

\* For definitions of Surface Distress Survey Data Options F1 and F2, see Section B.2.2. and ATTACHMENT D: VENDOR PAY ITEM BID SHEET (2012-2015).

The Vendor shall provide separately a one-time (pilot) software-detection/quantification of surface cracking data. (See Section B.2.8. for details.) Submittal of such shall be made to MDOT by June 10, 2012, with potential for granting of extension as described above due to weather delays, etc.)

Finally processed/reported images, IRI, rut, fault, GPS, and grade/curvature data for all seven (7) Regions - in compliance with requirements of this document - shall be provided within one month after the date of collection completion. The Vendor shall be subject to a \$5,000 penalty per each full week of delay for any single data type submittal.

Submittal due dates (as determined from time period requirements stated herein) falling on weekends or MDOT holidays will be shifted back to the next MDOT business work date.

On a weekly basis during collection, the Vendor shall provide MDOT access to collected/location-referenced images (see Section B.1.1. for requirements), and submit GPS, longitudinal profile, rut, fault, & grade/curvature data. This will facilitate MDOT QA sampling review and acceptance of the previous week's collection (location referencing begin/end points, proper environment criteria, acceptable image quality, IRI/rut/fault value verification, etc).

All data submittals shall be performed in a consistent, logically organized manner and shall be accompanied by a descriptive cover communication. The same shall be required for any re-submittals of data. FTP site-facilitated data submittals shall be preceded by descriptive Vendor e-mail notification to the MDOT Project Manager.

### 3. Collection Protocols

A.3.1. The Vendor shall continuously record synchronized digital images of the collection lane's pavement surface (single downview), the forward perspective view, and a rear-facing perspective view, where specified. The image taking device(s) shall provide clear digital images under natural lighting conditions. The downview shall be recorded in black-and-white; the forward- and rear-facing perspective views in color. The vehicle shall utilize artificial illumination to enhance downview images where natural lighting is inadequate (under bridges, in areas shadowed by trees, etc.).

A.3.2. Collection lane (right outside thru lane) width limit demarcations - both the left-side centerline and right-side edge line - shall be continuously visible in the single downview image except when necessary to change lanes. The aiming of the forward- and rear-facing perspective view devices shall be as directed by the MDOT Project Manager or his representative.

A.3.3. All data within an MDOT-defined pavement segment shall be collected in one continuous, unbroken pass and shall cover the entire length of the segment. Otherwise, the Vendor shall discard all collected data for the subject segment and recollect it to achieve continuity and completeness. Also, when at any time during a segment's collection, any data collection/measurement-supporting device malfunctions, all data collected to that point shall be discarded and the Vendor shall start again from the segment's beginning point.

Maximum vehicle speed during collection shall be 65 mph. Areas where collection speed is less than 15 mph shall be readily noted in the processed data submitted to MDOT.

A.3.4. Data shall be collected/processed on the right outside thru lane (truck lane). Allowable exceptions will be where merging traffic creates safety issues and where outside lanes are dropped/added. In those cases, a reasonable distance will be allowed by MDOT during QA review for vehicle adjustment to merging traffic and/or relocation back into the thru traffic/truck lane. (Refer to ATTACHMENT A - REQUIRED FIELD COLLECTION PROCEDURES - for more details regarding collection

requirements.) MDOT reserves the option of rejecting all data linked to a given pavement segment's collection (without payment) based on reasonable evidence during QA review that the Vendor's vehicle operator disregarded the requirements as stated here and elsewhere in this document.

- A.3.5. Data collection shall take place only when the pavement surface is dry and free of water staining, fog is not present, the existing natural lighting is adequate for good viewing of images, outside temperature is within collection equipments' recommended operating ranges, and no snow is present on the pavement and shoulder surfaces. These conditions shall be met for the entire length of a subject pavement segment's collection. Otherwise, the Vendor shall discard all collected data for the subject segment and recollect when all of the required conditions exist. During MDOT QA review, reasonable allowance will be provided for highly localized instances of water, fog, bad lighting, or snow depending on location of such in relation to the MDOT-defined segment's boundaries.
- A.3.6. Individually defined MDOT roadway segments shall be collected with the sun behind the vehicle or high in the sky for a predominant percentage of the segments total length. Every effort by the Vendor shall be made to avoid windshield or roadway glare as collection is scheduled from day to day. Collected imaging determined from MDOT QA review to have glare that hampers viewing of roadway features and condition will result in re-collection requirement.
- A.3.7. All data files shall be identified with a naming convention that ties the related data together for each pavement segment.
- A.3.8. The Vendor shall replace, at its expense and within one week of discovery & notice, any data storage devices which are damaged or lost prior to delivery to MDOT's C&T Office at 8885 Ricks Road, Lansing, Michigan.
- A.3.9. The perspective and downview images shall be continuously monitored by the Vendor's operators in real time during collection to ensure proper picture clarity and coverage completeness. MDOT reserves the right to observe images while the Vendor's vehicle is in use.
- A.3.10. MDOT reserves the right to require that the Vendor's longitudinal profiler meet compliance with the *Michigan Test Method for Certification of Profilers* (MTM 730). ([http://www.michigan.gov/documents/mdot\\_MTM\\_CombinedManual\\_83501\\_7.pdf](http://www.michigan.gov/documents/mdot_MTM_CombinedManual_83501_7.pdf)) prior to the start of each year's data collection, and after certain vehicle change instances during collection whereupon profile measurement equipment performance could be affected. The certification process would



be administered in the Lansing area by MDOT staff and take approximately half a day to conduct.

Additionally during collection, the Vendor shall visit the MDOT Lansing Office once each week to submit data collected during the previous week for MDOT QA and perform verification tests on the vehicle's distance measuring instrument, accelerometers, laser sensors (measured-mile, bounce test, ride and rut measure verification, etc.), and cameras under MDOT monitoring.

A.3.11. An annual kick-off meeting will be scheduled by MDOT to discuss, define and clarify aspects of the collection before commencement.

A.3.12. MDOT reserves the right to send an MDOT employee with the Vendor's vehicle during production collection for Quality Assurance checks.

#### 4. Time & Location Reference Identification

A.4.1. The vendor shall utilize a Set/Timecode raw data referencing system to link all collected data together during collection. A "Set" has traditionally been a grouping of data collected consecutively over an amount of time convenient for organizing data – equivalent to approximately two hours of time. A "Timecode" references hours:minutes:seconds:frames. Refer to ATTACHMENT F – FILE FORMATS OF LOCATION REFERENCING, DISTRESS, AND SENSOR DATA for further details. Data Sets shall be unique within each collection year; the Timecode linked to a particular Set shall be unique.

A.4.2. Collected data shall be linked to the MDOT-defined starting mileage point for a given pavement segment's beginning location, yet the Vendor's length measurement from that beginning point shall be used to define the ending mileage point of the pavement segment.

NOTE: This assumes that the Vendor's collection system has accurately marked the start/end limits at the proper physical reference points defined by MDOT for each pavement segment. Weekly MDOT QA will review such. (See ATTACHMENT A - REQUIRED FIELD COLLECTION PROCEDURES.)

Example:

A pavement segment is defined as starting at milepoint 0.0 and ending at milepoint 10.0 as provided by MDOT. Yet, the Vendor measures 10.1 miles between the proper start/end reference points during collection. Subsequent collection review by MDOT finds sufficient accuracy in the

Vendor's marking of the segment collection's start/end points. The submitted data shall, therefore, be labeled from milepoint 0.0 to 10.1.

Example:

A pavement segment is defined as starting at milepoint 10.0 and ending at milepoint 0.0. The Vendor's collection measures 10.1 miles between the proper start/end reference points and QA review finds accurate start/end definition during the collection. Therefore, the submitted data shall be labeled from milepoint 10.0 to milepoint -0.1.

- A.4.3. A collection log file shall be maintained by the Vendor (as collection progresses) linking collected data Set/Timecode information to each MDOT-defined pavement segment and MDOT's linear referencing system. The Vendor shall provide capability to readily associate any particular data type to other simultaneously collected data types through use of the Vendor's Set/Timecode system, MDOT's linear referencing system, or GPS referencing shall be provided. (Refer to ATTACHMENT F – FILE FORMATS OF LOCATION REFERENCING, DISTRESS, AND SENSOR DATA.)

## **B. DATA REQUIREMENTS**

### **1. Photo Log**

#### **B.1.1. Description:**

The Vendor shall collect digital images of the pavement down view, forward perspective view, and rear-facing perspective view. Images shall be in .jpeg format and contain EXIF data including (but not limited to) GPS referencing, MDOT roadway network linear referencing, and collection date. The images shall have a minimum resolution of 1440 x 1080.

The Vendor shall provide a managed hosting service via the Internet for all MDOT employees where they can view the images by selecting the desired network segment via MDOT region, county, route, linear referencing ID & milepoints, and via a GIS map displaying the same. Storage and management of the imaging for the host site shall be the Vendor's responsibility. In addition, the Vendor shall provide MDOT with "full rights" to the image data files for unlimited use and reproduction. A database table cross-referencing .jpeg image file names to GPS referencing and MDOT linear referencing data shall be provided to MDOT at the end of each annual collection season.

The software shall provide simulated “driving” of the selected network roadway segment by consecutive in-motion displaying of the sequentially collected images at user-defined “speed”. The user shall be able to examine a single frame, and have printing capability. The images shall be indexed and easily retrievable.

The software shall display the digital images of the right-of-way forward- & rear-facing perspective views (color) and vertical downview (black-and-white) of all designated lane-miles at 26.4' intervals (200 images per mile). Individual downview images shall cover the entire 26.4 feet between successive perspective view images. The software interface shall display MDOT linear referencing and geo-referencing (GPS) information simultaneously with the imaging. In addition, individual image files shall be readily extractable for MDOT (independent from Vendor-provided software) and shall contain an informational header superimposed within the image itself that includes GPS coordinates, date, and MDOT linear referencing (segment ID, travel direction, mile point, etc.). Prior to collection commencement, the Vendor shall discuss and finalize with the MDOT Project Manager configuration of metadata attributes to be provided within the image header and on-screen within the web-interface software.

The software shall allow for capture & database storage of roadway physical features including, but not limited to, guardrail, signs, signal poles, pavement markings, shoulder type, curb & gutter, sidewalk, bridges, lane types, and speed limit. The software shall provide accurate positioning capabilities for the user to determine/define milepoints, coordinates, and offset/height measurements of roadway features in relation to both MDOT’s linear referencing and other roadway features.

The Vendor shall provide updated access to collected/location-referenced images weekly during collection to facilitate MDOT weekly QA sampling review.

Images provided to MDOT for in-house use shall be delivered via portable, reliable, durable media maximizing storage or transfer efficiency in relation to current industry standards. Any managed hosting service, software, or hardware shall conform to MDOT IT network standards and requirements. All software, hardware, and shipping necessary to support image access and delivery for MDOT are the responsibility of the Vendor.

[MDOT reserves the right to independently provide all necessary hardware/software to facilitate MDOT-wide capability for viewing of Vendor-supplied roadway images and, correspondingly, to remove from the

contract the managed hosting service item (and associated costs) intended for the same purpose, without penalty.]

B.1.2. Collection & Imaging QA/Acceptance:

From MDOT's weekly QA sampling review of the Vendor's previously collected imaging and GPS data, collection location- and image-check status will be reported to the Vendor within one week after data receipt. Pavement segments found to have collection location, environment, or image quality errors will be reported to the Vendor as needing re-collection. Segment collections found to have correctable issues will be reported to the Vendor as needing re-adjustment prior to final data submittals.

Collection location issues to be checked will include, but not be limited to, proper pavement segment, accuracy of segment start/end locations, collection lane, and need for data elimination (due to construction zones, etc.). Collection environment review issues will include presence of fog, snow, or wet pavement. Image review issues will include, but not be limited to, coverage completeness, view angle, downview coverage width, brightness (presence of glare or shadowing excess), contrast, clarity, color.

2. Distress Type/Severity/Extent Identification

B.2.1. Processing:

Pavement surface distress surveying (type/severity/extent identification) shall be conducted in accordance with ATTACHMENT G – DISTRESS MANUAL FOR SURVEYING OF PAVEMENT SURFACE IMAGES. The delivered data files shall conform to format and logic requirements described in both ATTACHMENT G and ATTACHMENT F – FILE FORMATS OF LOCATION REFERENCING, DISTRESS, AND SENSOR DATA.

An exception to the above processing requirement shall exist for the Vendor's one-time pilot study provision of software-detected/quantified surface cracking data – See Section B.2.8. for details.

B.2.2. Survey Technique:

The Vendor shall use a survey technique that utilizes trained personnel working with equipped workstations and software to view images, perform visual distress pattern recognition, and record distress type, severity, extent characteristics in conformance with the methodology outlined in ATTACHMENT G. An exception to this technique requirement shall exist for the Vendor's one-time pilot study provision of software-

detected/quantified surface cracking data – See Section B.2.8. for details.

Mileage Coverage, Options F1/F2, and “Not-Sampled Area” PD Call – Each pavement segment’s distress survey file created by the Vendor shall account for the entire associated mileage range defined by MDOT. If MDOT chooses Distress Survey Data Option F2 (the network sampling option - refer to ATTACHMENT D - VENDOR PAY ITEM BID SHEET (2012-2015)), the Vendor shall insert “Not-Sampled Area” Primary Distress (PD) coding within each created file to cover specific locations defined by MDOT. Those locations will have been determined as areas to not receive Vendor-performed distress type/severity/extent surveying. Upon MDOT’s decision to utilize Option F2, the Vendor will be provided annually with a file listing of each pavement segments milepoint range and whether or not Vendor surveying shall, or shall not, be performed. (See ATTACHMENT F - FILE FORMATS OF LOCATION REFERENCING, DISTRESS, AND SENSOR DATA for example file format.) Mileage ranges specified by MDOT within that file for “Not-Sampled Area” coding will not be included for Distress Survey Data payment mileage computation.

Regardless of MDOT’s choice of F1 or F2, MDOT’s weekly collection location review will require the Vendor to insert a (separate) “Not Surveyed” coding for locations where construction or detouring has hindered data collection on the desired pavement segment or survey lane.

**B.2.3 Survey Technique Flexibility:**

MDOT might require modifications to its defined surface distress data formatting or type/severity/extent identification methodology during the period of the contract in order to stay current with the MDOT business needs. The Vendor’s survey process shall possess reasonable flexibility in order to adapt to such potential modification requirements.

**B.2.4 Quality Control Plan:**

The Vendor shall have a documented quality control plan that addresses the accuracy, consistency and completeness of the created distress survey data.

**B.2.5. Delivery:**

Every pavement segment distress survey data file shall be processed and delivered to MDOT in the format specified within ATTACHMENT F. Delivery timeframe and method requirements have been defined previously in Section A.2.2.

**B.2.6. MDOT Quality Assurance and Acceptance:**

The distress survey data shall pass through an MDOT sequential system of

verification and quality assurance checks for proper format, coding logic, and survey call accuracy. MDOT will verify Vendor survey call accuracy via comparison of submitted file content to the collected pavement images. For this, MDOT will utilize the Vendor's provided access for simultaneous viewing of forward perspective, rear-facing perspective, and pavement downview images via MDOT's location reference system.

The MDOT Project Manager must provide written approval prior to payment for received and accepted data. Payment will be made on a milestone basis as follows:

Milestone 1: 50% of the unit price per mile\* for distress survey data will be paid for each LocID passing initial logic check.

Milestone 2: 35% of the unit price per mile\* for distress survey data will be paid for each LocID passing survey call quality level check.

Milestone 3: 15% of the unit price per mile\* for distress survey data will be paid for each LocID within a Region when all LocIDs within the Region have passed both initial logic check and survey call quality level check.

\* Payable mileage for distress survey data shall be based on either the total individual LocID length (as defined in MDOT's provided annual TapeLog file) for Pay Item Option F1, or the combined length of all MDOT-specified survey-sample segment lengths within an individual LocID for Pay Item Option F2.

Milestones 1 and 2 are further described below.

Quality assurance check results for the Vendor's submitted Region distress survey files will be reported to the Vendor by Region.

Milestone 1: MDOT will supply the Vendor with access to MDOT-developed logic checking software for distress survey data files (via an FTP site). This will provide the Vendor the opportunity to preliminarily check data format and logic prior to final submittal. MDOT will then, upon receipt of finalized data, process the data with the same software to determine format and logic acceptability.

Milestone 2: Surface distress survey calls will be sampled (by mileage) and tested as described in ATTACHMENT H - DISTRESS SURVEY CALL SAMPLING, TESTING, & ACCEPTANCE CRITERIA, and shall meet quality levels defined therein for acceptance and payment. Distress data that fail to meet those MDOT quality assurance accuracy requirements will

be rejected. Results of MDOT distress data QA will be communicated back to the Vendor. Once MDOT has completed its initial QA reporting of a given Region's distress survey data set status, the Vendor shall have two weeks to complete corrections and resubmit all distress data initially reported by MDOT as failing. For any subsequently failing data files of a given Region further reported to the Vendor, correction and re-submittal shall be made within one week after the report. The Vendor shall be subject to a \$5,000 penalty per each full week of delay for any single data re-submittal.

B.2.7. Software:

The Vendor's software used for manual observation/recording of pavement distress via image observation (with MDOT's location referencing system) shall be provided to MDOT for use in its QA review.

B.2.8. Pilot Study Software-Detected/Quantified Surface Cracking Data:

The Vendor shall utilize image collection and software capable of detecting and quantifying pavement surface cracking to create and submit for a limited, one-time basis within the 2012 collection year. The utilized methodology shall follow the 2010 AASHTO Provisional Standards PP67-10 and PP68-10. The software shall be capable of meeting criteria defined within the FHWA's Highway Performance Monitoring System (HPMS) Field Manual for detection and quantification of both the *Cracking\_Length* and *Cracking\_Percent* attribute values for varying pavement surface types. (<http://www.fhwa.dot.gov/policy/ohpi/hpms/fieldmanual>)

The Vendor shall provide the software-generated quantifications in 0.1-mile segmentation within a single report format for all 2012-year Eaton and Ingham County distress survey locations as defined by MDOT (approximate total mileage = 240 miles). The Vendor shall provide documentation that explains the software's utilized algorithms.

3. Transverse and Longitudinal Profile

B.3.1. Description:

The longitudinal profile for ride shall be measured in both the right and left wheel paths of the lane for which the data are being collected. Rut measurement calculations shall be performed for each wheel path of the lane for which the data are being collected. Fault detection measurements shall be performed across the width of the lane for which the data are being collected. Rut data collection will be required only on flexible and composite pavement surfaces; fault data collection will be required only on rigid and composite pavement surfaces. MDOT will specify such locations

for the Vendor – see ATTACHMENT F for example file format that will be provided annually.

**B.3.2. Equipment, Measurement, Operation, and Computation:**

The measuring vehicle shall be capable of collecting profile data via laser measurement at the posted highway speeds (65 mph maximum) with an inertial profiler in accordance with ASTM E950 (active version) Class 1 accuracy and specification requirements. The vehicle shall be equipped with all necessary transducers, computing and recording equipment to measure and record elevation data from the pavement surface as specified within ASTM E950 (active version) and as defined herein. Equipment, methodology, and operators shall comply with the noted applicable 2010 AASHTO specifications listed in ATTACHMENT B of this document.

Wheelpath rut depth determination shall be accomplished through measurement of the transverse profile with technology that provides more than 1000 data points across the entire collection lane width. The methodology shall utilize algorithms to remove surface texture effects, compensate for vehicle lateral wander, and resolve a string-line rut value for each wheelpath. The methodology shall comply with applicable 2010 AASHTO specifications listed in ATTACHMENT B.

Profile measurement processing and computation for determination of the International Roughness Index (IRI) shall comply with applicable 2010 AASHTO specifications listed in ATTACHMENT B.

The record file for the longitudinal profile data (including processed 0.1-mile data files) shall be embedded with coding to distinguish the location of occurrences that interrupt the continuity of the profile within a segment. The following occurrences shall be identified with reference coding within the submitted data file (including 0.1-mile aggregated file) that includes both their starting and ending MDOT location referencing mileage points.

- a. bridge deck (not including culverts).
- b. railroad crossing.
- c. construction zone (travel required outside the designated collection lane - e.g.: detour or traffic shift)
- d. where collection occurs outside the right thru lane.
- e. low travel speeds (vehicle speed is below 15 mph)

-Segment collection locations associated with occurrences “c” and “e” above shall be excluded from IRI calculations.

-Segment collection locations associated with occurrences “b”, “c” and “e” shall be excluded from calculations for wheel path rut, and fault.



**B.3.3. Software and Documentation:**

All software shall be provided by the Vendor to process the collected profiles into International Roughness Index (IRI), rut, and fault measurements as specified. Submitted final data for IRI, rut, fault, and grade measurements shall include processed 1/10-mile summary formatting, but Vendor software shall provide capability for processing summary data at any longitudinal interval length (0.1-mile, 0.5-mile, etc.) Within each 0.1-mile report file, in addition to fields for MDOT location reference begin/end mile points and the subject measurement values, indices and/or statistics, there shall be separate fields displaying the route name, date of collection, pavement surface temperature, begin/end GPS coordinates, instances a through e noted in Section B.3.2. Individual data measurement or statistic record cells (location referencing cells excluded) for mileage ranges that MDOT, from weekly QA review, has directed to be marked as “Not Surveyed” (due to construction, detour, non-applicable pavement type, etc.) shall be left blank.

The Vendor shall provide documentation of the rutting measurement method used, including the algorithms. Rut depth average and maximum values for each wheel path shall be processed by the Vendor and reported for every 0.1-mile. Methodology shall comply with applicable 2010 AASHTO specifications listed in ATTACHMENT B.

The Vendor shall provide documentation of fault detection/measurement method used, including algorithms. Number of faults detected and average height of faults detected shall be processed and reported for every 0.1-mile. Methodology shall comply with applicable AASHTO specifications listed in 2010 ATTACHMENT B.

**B.3.4. Quality Control/Calibration:**

The Vendor shall have a documented plan for controlling accuracy quality of the measured profile data, including procedures for checking and calibrating its collection sensor, transducer, and recording equipment in compliance with equipment manufacturers’ recommendations. The plan shall include an estimate of the precision of the measurement process, and description of a real-time, onboard verification practice to assure that valid data are being recorded. The plan shall be submitted to MDOT upon contract execution.

**B.3.5. MDOT Quality Assurance and Acceptance:**

MDOT will execute verification checks of Vendor-collected distance, ride, rut, and fault data using Vendor equipment manufacturer specifications,

MDOT equipment-collected data, required Vendor test-runs, and/or historically collected data. The Vendor collection vehicle shall return to Lansing weekly to submit collected data for QA sampling review and to collect specific local roadway sections for separate MDOT verification.

The Vendor's operators shall have the ability while in Lansing to readily provide MDOT with collected raw data, along with either the processed data or the associated processing software for QA verification checks.

As stated previously (Section A.2.2.), the Vendor shall submit final formatted profile data to MDOT within one month after the completion of the subject year's collection. The final data shall pass through an MDOT sequential system of verification and quality assurance checks for proper formatting, coverage completeness, and reasonably expected value ranges. Results of MDOT's quality assurance review & testing will be provided to the Vendor within six weeks after receipt of the Vendor's data submittal. The Vendor shall resubmit corrected data (as required) within two weeks after MDOT has communicated its initial QA status results. The Vendor shall be subject to a \$5,000 penalty per each full week of delay for each of the profile data set's initial and subsequent submittals. The entire statewide (seven Regions) profile data set shall have passed MDOT QA prior to written approval for payment being made by the MDOT Project Manager.

#### 4. Grade and Curvature

##### B.4.1. Description:

The Vendor shall measure, collect, calculate and report data related to transverse cross slope, longitudinal grade, and roadway alignment vertical/horizontal curvature.

##### B.4.2. Equipment and Measurement:

The Vendor's vehicle shall be equipped with all necessary transducers, computing and recording equipment to measure and record grade and curvature data. State-of-the-practice gyroscope and differential GPS inertial navigation equipment and methodologies shall be utilized. The vehicle shall be capably equipped to collect the data at posted highway speeds (65 mph maximum).

##### B.4.3. Calibration:

A written plan, as to how the Vendor's collection equipment calibration will take place, shall be submitted to MDOT upon contract execution for MDOT review & approval prior to collection commencement. As a minimum requirement, sufficient calibration procedures shall apply to the vehicle

transducers and recording equipment and shall include adherence to all equipment manufacturers' recommendations.

**B.4.4. Quality Control Plan:**

The Vendor shall have a quality control plan that addresses, as a minimum, the accuracy of the measured grade and curvature data. The current plan shall be submitted to MDOT upon contract execution for MDOT review & approval prior to collection commencement. The plan shall include an estimate of the precision of the measurement process. Some form of real time, on-board verification shall be in place to assure that valid data are being recorded.

**B.4.5. MDOT Quality Assurance:**

The Vendor shall provide readily available data processing, calculation, and downloading from the collection vehicle system on a weekly basis for MDOT quality assurance verification check purposes. The Vendor's vehicle operators shall be readily capable of performing such tasks.

MDOT reserves the right to use MDOT equipment and resources for verification of the Vendor's data quality. MDOT reserves the right to require the Vendor's collection vehicle to collect specific roadway sections in Lansing on a weekly basis for such verification. Equipment manufacturer specifications, MDOT-collected measurements, and/or as-built design details will be utilized for quality verification of Vendor data.

**B.4.6. Reporting:**

Generated grade/cross-slope measurement reports shall utilize a reporting interval specified by MDOT. While an interval of 0.1-mile is typical, the vendor shall have the ability to vary the reporting interval to meet MDOT special report needs. Each reporting interval record shall include, Grade (percent – average for reporting interval), Cross-Slope (percent – average for reporting interval), and other metadata including MDOT linear referencing and GPS coordinates – See ATTACHMENT F for further details.

Generated curvature measurement reports shall describe a continuous progression of mileage with each separately detected alignment feature type occupying a single report record. Separate reports shall be created for vertical and horizontal alignments. Each horizontal alignment report record shall include feature type (either angle point, independent horz. curve, component of compound curve, component of reverse curve, or tangent section), start of feature, end of feature, radius, degree of curvature, maximum superelevation, length of curve, spiral transition presence, deflection angle, and direction of curve or deflection angle. Each vertical

alignment report record shall include feature type (vertical angle point, sag, crest, or gradient), start of feature, end of feature, K factor, curve length, gradient length, and percent of gradient. Both reports shall also include other metadata including MDOT linear referencing and GPS coordinates - See ATTACHMENT F of this document for required report formats.

**B.4.7. Final Submittal and Acceptance:**

The Vendor shall submit to MDOT processed measurement data for the entire state in the specified report format within one month after the completion of each year's collection. The data shall pass through an MDOT sequential system of final verification and quality assurance checks for proper formatting, coverage completeness, and reasonably expected value ranges. MDOT reserves the right to compare submitted data to MDOT measurements and/or as-constructed design details for quality verification and acceptance purposes.

Results of MDOT's final QA review & testing will be provided to the Vendor within six weeks after receipt of the Vendor's data submittal. The Vendor shall resubmit corrected data (as required) within two weeks after MDOT has communicated its initial QA status results. The Vendor shall be subject to a \$5,000 penalty per each full week of delay for each of the dataset's initial and subsequent submittals. The entire season's dataset shall pass MDOT QA prior to written approval for payment being made by the MDOT Project Manager.

**5. Global Positioning System (GPS) Coordinates**

**B.5.1. Description:**

The Vendor shall collect and provide corrected GPS longitude (X) and latitude (Y) coordinates along all MDOT-defined pavement segments.

**B.5.2. Corrections:**

GPS coordinates shall be real-time corrected via utilization of the WAAS (Wide Area Augmentation System). Therefore, the Vendor shall utilize a WAAS-enabled GPS receiver.

B.5.3. Accuracy:

The Vendor shall provide WAAS correction accuracy. (WAAS performance specifications require 95% horizontal and vertical position accuracy within 25 feet.)

B.5.4. Deliverables:

The GPS//WAAS X and Y coordinates shall be readily linkable and submitted/reported along with all other Vendor-delivered image and roadway alignment/condition measurement data. Delivered coordinate data shall be in standard geographic data format and compatible with MDOT's geographic mapping programs. Additionally, GPS/WAAS coordinates shall be included within all processed 1/10-mile and other-formatted data files required (elsewhere in this document) for submittal to MDOT within one month after completion of the each year's collection.

B.5.5. Quality Control Plan:

The Vendor shall have a documented plan addressing the frequency, comprehensiveness, and accuracy of the corrected GPS/WAAS data.

B.5.6. MDOT Quality Assurance and Acceptance:

The Vendor shall provide previously collected GPS/WAAS coordinate data to MDOT on a weekly basis during collection. MDOT will review the data, using MDOT equipment, for location coverage frequency, completeness, and accuracy. Resultant issues found with the data will be reported to the Vendor within one week of data receipt.

After post-collection receipt of finally reported IRI, rut, fault, and grade/curvature data, any further MDOT verification-check issues found with the GPS data will be reported to the Vendor within six weeks after data receipt. The Vendor shall correct the data set (as required) and re-submit to MDOT within two weeks after communication of MDOT's verification results. The MDOT Project Manager must provide written acceptance of the entire annually collected GPS data set prior to payment.

## **ATTACHMENT A**

### **Pavement Condition Data/Right-of-Way Image Collection and Processing 2012 - 2015**

## **REQUIRED FIELD COLLECTION PROCEDURES**

### **1. Start and End Locations:**

The beginning and ending locations of a MDOT-defined pavement segment shall be properly demarcated as data are collected in the field through utilization of descriptions and GPS coordinates provided by MDOT. Typical MDOT pavement segment beginning and ending point descriptions include references to cross road intersections, county line signs, junctions with other routes, or gore points of ramps.

For all segments: While the begin and end location descriptions provided by MDOT are for Vendor general guidance, the MDOT-provided GPS coordinates point shall be utilized by the Vendor to locate and demarcate during collection the exact begin or end point of a segment. Instances of significant disagreement between MDOT-provided begin/end location descriptions & GPS coordinate data shall be referred to MDOT for consultation.

If the vehicle is to turn directly around to pick up the opposite direction of pavement segment direction just completed, the start of that opposite direction's collection shall not be marked by the operator until the vehicle is actually turned around and is at the MDOT-defined start location for that direction's collection.

If one defined pavement segment ends and another begins at the same intersection/point, yet a turn must be made in order to follow the next segment, then the vehicle shall first pass straight through and demarcate the end of the first segment data. Then, the vehicle shall be positioned on the intersection leg opposite of the next segment and the start of its collection shall be demarcated at the same point. Segment start and end points that are simply demarcated as the vehicle turns the corner will be considered by MDOT for rejection and re-collection requirement.

MDOT's acceptance tolerance for each collection begin/end point demarcation will be +/- 25 feet (straight-line measured from MDOT's provided GPS coordinate pair). MDOT reserves the options of either rejecting collection (or data) that show reasonable evidence that the tolerance is not being met, or specifying data adjustment by the Vendor for correction. MDOT will execute this tolerance checking procedure during its weekly QA reviews of collected GPS and right-of-way/pavement image data.

**2. Incorrect or Incomplete Collection:**

When the Vendor operators in the field have collected a pavement segment's data incorrectly location-wise (beginning point, ending point and/or in-between somewhere), or with some malfunctioning piece of equipment, or within unacceptable circumstances (wet weather, excessive speeds, etc.), steps shall be immediately taken to purge the affected data and re-collect with proper locationing, properly operating equipment and/or proper circumstances. This shall be done in order to obtain MDOT's desired continuous, unbroken, complete and accurate set of data for the pavement segment. The Vendor operators' strict compliance to these required collection details will be most advantageous by minimizing the need for post-editing tracking and the additional chance of associated human error introduction.

**3. Collection Lane, Passing & Merging:**

Collection shall be performed in the far right thru lane where the most severe pavement distress predominantly exists. Passing shall be done only for traffic safety purposes. When there are vehicles merging from a ramp, the Vendor vehicle should move to the inside (left) lane as safety necessitates, and either speed up or slow down in order to safely return to the far right lane as soon as possible. The Vendor operator shall maintain a minimum distance between the collection van and any preceding vehicle. Also, the Vendor operator shall minimize travel time spent alongside large trucks that may be passing on the van's left. These actions are required during collection to provide sufficient forward perspective view imaging of the roadway ahead to facilitate:

- a) Proper distress characterization during the subsequent pavement survey process.
- b) Various viewing needs of MDOT end-users.

**NOTE:** Post-collection distress surveying shall properly identify which lane is being surveyed. (Lane #1 is far right thru lane, with lane numbering increasing as collection moves to the left across the roadway.)

**4. Measurement Verification Testing:**

The Vendor operators shall run verification tests for collection equipment measurement in Lansing on a weekly basis as directed by MDOT. These tests shall include, but not be limited to, distance, ride, and camera alignment measurements.

**5. Construction and Detour Areas - Data Collection and Processing Requirements:**

When the collection vehicle approaches an ongoing construction project (or detour), or a location where it is evident that collection on the proper roadway and/or in the proper lane is impossible, then the Vendor operators shall mark within the data the starting and ending MDOT location referencing mile points (as measured along the proper roadway; not along a detour) of such occurrence. The submitted surface distress survey data for the subject pavement segment shall

then have that mileage range called out and defined (within all submitted data) as a “Not Surveyed” area (Code 0908).

This shall also pertain to construction areas where no detour exists, but traffic is shifted over to the opposite direction’s lane in traveling through the construction zone.

All processed sensor data that is submitted for such areas shall also be marked to clearly indicate where data collection has occurred within a construction area, or along detour, and therefore, is not useable.

Example of Required Mileage Adjustment for Data Submittal:

A pavement segment to be collected is defined by MDOT location referencing from mile point 0.000 to 10.000. However, during collection the vehicle was detoured starting at mile point 4.000, then traveled 4.000 miles until it was back on the proper route for collection, and from there collected another 4.000 miles before reaching the proper ending point. That’s 12.000 miles actually traveled, but the data must refer to the proper location referencing mileage range along the proper route only (0.000 to 10.000). Therefore, the Vendor shall have to calculate exactly what MDOT location referencing mileage range (along proper roadway) was missed due to detour (or construction zone in simpler case) and modify the data accordingly for submittal:

The vehicle collected from 0.000 to 4.000 along the proper route before the detour, then made 4.000 more miles of collection on the proper route once off of the detour before reaching the ending reference point. Therefore, 2.000 miles along the proper route (mile point 4.000 to 6.000) was not collected due to construction, and should be marked in the submitted data accordingly.

**NOTE:** MDOT will, upon initially reviewing GPS and right-of-way/pavement imaging data for weekly acceptance, indicate to the Vendor the start & end locations associated with detour and/or construction limits, for which final data shall be marked (“Not Surveyed” coding in distress survey data; blank measurement field values in final IRI, rut, fault data). The Vendor shall make such adjustments within final data prior to submittal to MDOT.



## **ATTACHMENT B**

### **Pavement Condition Data/Right-of-Way Image Collection and Processing 2012 - 2015**

#### **APPLICABLE AASHTO STANDARD SPECIFICATIONS**

The Vendor shall comply with the following 2010 AASHTO Standard & Provisional Specifications applicable to the data collection & processing required within this contract:

##### **AASHTO Standard Specifications**

M 328-10	Inertial Profiler
R 36-04 (2009)	Evaluating Faulting of Concrete Pavements
R 43M/R 43-07	Quantifying Roughness of Pavements
R 57-10	Operating Inertial Profiling Systems

##### **AASHTO Provisional Standards**

PP 67-10	Quantifying Cracks in Asphalt Pavement Surfaces from Collected Images Utilizing Automated Methods (Applicable only to pilot software-detected/quantified surface cracking data)
PP 68-10	Collecting Images of Pavement Surfaces for Distress Detection (Applicable only to pilot software-detected/quantified surface cracking data)
PP 69-10	Determining Pavement Deformation Parameters and Cross Slope from Collected Transverse Profiles
PP 70-10	Collecting the Transverse Pavement Profile

## ATTACHMENT C

### 2012 - 2015 Collection & Delivery Schedule

ITEM	COVERAGE	2012	2013	2014	2015
<b>Collection Start</b>	-	1-Apr	1-Apr	1-Apr	1-Apr
<b>Collection End</b>	-	15-Jul	24-Jun	17-Jun	24-Jun
<b>Distress Survey Option F1 Delivery</b>	1st Region	27-May	27-May	27-May	27-May
	2nd Region	24-Jun	24-Jun	24-Jun	24-Jun
	3rd Region	22-Jul	22-Jul	22-Jul	22-Jul
	4th Region	19-Aug	19-Aug	19-Aug	19-Aug
	5th Region	16-Sep	16-Sep	16-Sep	16-Sep
	6th Region	14-Oct	14-Oct	14-Oct	14-Oct
	7th Region	11-Nov	11-Nov	11-Nov	11-Nov
<b>Distress Survey Option F2 Delivery</b>	1st Region	13-May	13-May	13-May	13-May
	2nd Region	27-May	27-May	27-May	27-May
	3rd Region	10-Jun	10-Jun	10-Jun	10-Jun
	4th Region	24-Jun	24-Jun	24-Jun	24-Jun
	5th Region	8-Jul	8-Jul	8-Jul	8-Jul
	6th Region	22-Jul	22-Jul	22-Jul	22-Jul
	7th Region	12-Aug	12-Aug	12-Aug	12-Aug
<b>Software-Detected Distress Survey Delivery</b>	Partial University Region	10-Jun	-	-	-
<b>Laser Sensor (IRI, Rut, Fault) Delivery</b>	All Regions	15-Aug	24-Jul	17-Jul	24-Jul
<b>GPS Delivery</b>	All Regions	15-Aug	24-Jul	17-Jul	24-Jul
<b>Images Delivery</b>	All Regions	15-Aug	24-Jul	17-Jul	24-Jul
<b>Grade/Curvature Delivery</b>	All Regions	15-Aug	24-Jul	17-Jul	24-Jul

Granting of extensions due to delays reasonably beyond the Vendor's control (bad-weather days, as example, but not equipment failures) will be considered by MDOT upon review of the Vendor's explanation.

## ATTACHMENT D

### **Pavement Condition Data/Right-of-Way Image Collection and Processing**

#### **VENDOR PAY ITEM BID SHEET (2012-2015)**

##### **1. Field Data Collection/Measurement (Vehicle Operation)<sup>1</sup>:**

Total 4-Year Estimated Miles = 37,925  
(Year 2012 = 10,825 miles; 2013 = 8,625 miles; 2014 = 9,850 miles; 2015 = 8,625 miles)

Proposed Cost per Mile<sup>1</sup> = \_\_\_\_\_  
Proposed 4-Year Subtotal Contract Cost = \_\_\_\_\_

<sup>1</sup> The proposed cost per mile for this item shall not exceed 20% of the sum of proposed costs per mile for all items except Item F2 under “2. Processed Data” below.

##### **2. Processed Data:**

###### **A1. Digital Images [Forward R.O.W. View (1440x1080) & Pavement DownView]:**

Total 4-Year Estimated Miles = 24,280  
(Year 2012 = 6,200 miles; 2013 = 5,940 miles; 2014 = 6,200 miles; 2015 = 5,940 miles)

Proposed Cost per Mile = \_\_\_\_\_  
Proposed 4-Year Subtotal Contract Cost = \_\_\_\_\_

###### **A2. Digital Image [Rear-Facing R.O.W. View (1440x1080)]:**

Total 4-Year Estimated Miles = 14,970  
(Year 2012 = 5,750 miles; 2013 = 1,735 miles; 2014 = 5,750 miles; 2015 = 1,735 miles)

Proposed Cost per Mile = \_\_\_\_\_  
Proposed 4-Year Subtotal Contract Cost = \_\_\_\_\_

###### **B. Longitudinal Surface Profile - IRI Data:**

Total 4-Year Estimated Miles = 37,925  
(Year 2012 = 10,825 miles; 2013 = 8,625 miles; 2014 = 9,850 miles; 2015 = 8,625 miles)

To include: a) Raw Profile Measurements (Single-point laser basis)  
b) 1/10<sup>th</sup>-mile segment calculations & statistics for IRI per wheelpath

Proposed Cost per Mile = \_\_\_\_\_  
Proposed 4-Year Subtotal Contract Cost = \_\_\_\_\_

**C. Transverse Surface Profile – Wheelpath Rut Data:**

Total 4-Year Estimated Miles = 19,920  
(Year 2012 = 5,950 miles; 2013 = 4,010 miles; 2014 = 5,950 miles; 2015 = 4,010 miles)

To include: a) Raw Profile Measurements (scanning laser basis)  
b) 1/10<sup>th</sup>-mile segment calculations & statistics for each wheelpath

Proposed Cost per Mile = \_\_\_\_\_  
Proposed 4-Year Subtotal Contract Cost = \_\_\_\_\_

**D. Surface Profile - Joint/Crack Fault Data:**

Total 4-Year Estimated Miles = 13,940  
(Year 2012 = 2,645 miles; 2013 = 4,325 miles; 2014 = 2,645 miles; 2015 = 4,325 miles)

To include: a) Raw Detection Data (multi-laser-point-across-lane basis)  
b) 1/10<sup>th</sup>-mile segment calculations & statistics

Proposed Cost per Mile = \_\_\_\_\_  
Proposed 4-Year Subtotal Contract Cost = \_\_\_\_\_

**E. Global Positioning System (GPS) Coordinates:**

Total 4-Year Estimated Miles = 37,925  
(Year 2012 = 10,825 miles; 2013 = 8,625 miles; 2014 = 9,850 miles; 2015 = 8,625 miles)

To include: a) Real-Time correction via WAAS  
b) Latitude (Degrees)  
c) Longitude (Degrees)

Proposed Cost per Mile = \_\_\_\_\_  
Proposed 4-Year Subtotal Contract Cost = \_\_\_\_\_

\* **F1. Surface Distress Survey Data – 100% Sample Rate:**  
**Total 4-Year Estimated Miles = 24,280**  
**(Year 2012 = 6,200 miles; 2013= 5,940 miles; 2014 = 6,200 miles; 2015 = 5,940 miles)**

**Proposed Cost per Mile = \_\_\_\_\_**  
**Proposed 4-Year Subtotal Contract Cost = \_\_\_\_\_**

\* **F2. Surface Distress Survey Data – 30% Sample Rate:**  
**Total Estimated Miles = 7,290**  
**(Year 2012 = 1,860 miles; 2013 = 1,785 miles; 2014 = 1,860 miles; 2015 = 1,785 miles)**

**Proposed Cost per Mile = \_\_\_\_\_**  
**\*Proposed 4-Year Subtotal Contract Cost = \_\_\_\_\_**

**G. Software-Detected/Quantified Surface Cracking Data:**  
**Total 4-Year Estimated Miles = 240**  
**(Year 2012 = 240 miles)**

**Proposed Cost per Mile = \_\_\_\_\_**  
**Proposed 4-Year Subtotal Contract Cost = \_\_\_\_\_**

**H. Grade and Curvature Data:**  
**Total 4-Year Estimated Miles = 12,230**  
**(Year 2012 = 6,200 miles; 2013 = 5,970 miles; 2014 = 30 miles; 2015 = 30 miles)**

**To include: a) Long. Grade and Cross-Slope Measures**  
**b) Horizontal & Vertical Alignment Features Detection/Measurement**

**Proposed Cost per Mile = \_\_\_\_\_**  
**Proposed 4-Year Subtotal Contract Cost = \_\_\_\_\_**

**3. Software for MDOT Data Quality Assurance and Management:**  
**Supply and Operation/Maintenance Support**

**Proposed Cost per Year = \_\_\_\_\_**  
**Proposed 4-Year Subtotal Contract Cost = \_\_\_\_\_**

**4. \*\*Hardware for MDOT Data Quality Assurance and Management:  
Supply and Operation/Maintenance Support**

Proposed Cost per Year = \_\_\_\_\_  
Proposed 4-Year Subtotal Contract Cost = \_\_\_\_\_

**5. \*\*Internet Managed Hosting Service for MDOT-wide PhotoLog:  
Site Creation, Management, Maintenance, and Data Storage**

Proposed Cost per Year = \_\_\_\_\_  
Proposed 4-Year Subtotal Contract Cost = \_\_\_\_\_

**\* PROPOSED 4-YEAR TOTAL BID (for Low-Bid Determination)**  
**(Includes Data Item F2)** = \_\_\_\_\_

**\* PROPOSED 4-YEAR NOT-TO-BE-EXCEEDED CONTRACT TOTAL**  
**(Excludes Data Item F2)** = \_\_\_\_\_

\* For the purpose of low-bid selection, the Subtotal amount for Item F2 shall be included in the PROPOSED 4-YEAR TOTAL BID. For contract execution, however, the Subtotal amount for Item F2 shall be excluded from the PROPOSED 4-YEAR NOT-TO-BE-EXCEEDED CONTRACT TOTAL. Items F1 and F2 are mutually exclusive contract options and will be administered as follows: Prior to the first year's collection commencement, MDOT will choose to begin with either F1 or F2. If F1 is chosen, MDOT reserves the right to subsequently make a one-time transition to F2 (before the start of the next full collection year) and complete the contract under F2. If F2 is initially chosen, the entire contract term will be conducted under F2.

\*\* MDOT reserves the right to remove these items individually from the contract via documented notice to the Vendor prior to the start of any single year's collection.

**Vendor Pay Item Bid Sheet Validation**

Authorized Vendor Representative:

\_\_\_\_\_  
Printed Name

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

Full Address:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## **ATTACHMENT E**

### **Pavement Condition Data/Right-of-Way Image Collection and Processing**

**Years 2012 - 2015**

## **PAYMENT STRUCTURE & CRITERIA**

### **1. Review/Acceptance of Data Collection (Vehicle Operation)**

Criteria: All annually scheduled statewide collection segments must be validated as “properly collected” via the MDOT review/acceptance process as defined in this Scope of Services.

Payment: After MDOT determines criteria are met by Vendor, one single payment (in dollars) will be made per year. The payment amount will be the calculated product of the annual statewide mileage specified\*\*\* (estimated in Attachment D - Item 1) and the Vendor’s bid unit price per mile for field data collection. There will be four separate payments of this type over the life of the contract.

### **2. Submittal/Acceptance of Processed Data**

#### **A) Right-of-Way & Pavement Surface Digital Images**

Criteria: All digital images associated with annually scheduled statewide collection segments shall pass through the MDOT review & acceptance process as defined in this Scope of Services.

Payment: After MDOT determines criteria are met by Vendor, two payments (in dollars) will be made per year – one per each of Item 2A1 & 2A2 in Attachment D. Each payment amount will be the calculated product of the respective annual statewide mileage specified\*\*\* (estimated in Attachment D) and the Vendor’s bid unit price per mile for each Item. There will be two separate payments of this type for each year over the life of the contract.

#### **B) Longitudinal Surface Profile – IRI Data**

Criteria: All processed IRI-related measurement/reporting data associated with annually scheduled statewide collection segments shall pass through the MDOT review & acceptance process as defined in this Scope of Services.

Payment: After MDOT determines criteria are met by Vendor, one single payment (in dollars) will be made per year. The payment amount will be the calculated product of the annual statewide mileage specified\*\*\* (estimated in Attachment D - Item 2B) and the Vendor’s bid unit price per mile for longitudinal surface profile – IRI data. There will be four separate payments of this type over the life of the contract.



**C) Transverse Surface Profile – Wheelpath Rut Data**

Criteria: All processed wheelpath rut-related measurement/reporting data associated with annually scheduled statewide collection segments shall pass through the MDOT review & acceptance process as defined in this Scope of Services.

Payment: After MDOT determines criteria are met by Vendor, one single payment (in dollars) will be made per year. The payment amount will be the calculated product of the annual statewide mileage specified\*\*\* (estimated in Attachment D - Item 2C) and the Vendor's bid unit price per mile for transverse surface profile – wheelpath rut data. There will be four separate payments of this type over the life of the contract.

**D) Surface Profile – Joint/Crack Fault Data**

Criteria: All processed joint/crack fault-related measurement/reporting data associated with annually scheduled statewide collection segments shall pass through the MDOT review & acceptance process as defined in this Scope of Services.

Payment: After MDOT determines criteria are met by Vendor, one single payment (in dollars) will be made per year. The payment amount will be the calculated product of the annual statewide mileage specified\*\*\* (estimated in Attachment D - Item 2D) and the Vendor's bid unit price per mile for surface profile – joint/crack fault data. There will be four separate payments of this type over the life of the contract.

**E) Global Positioning System (GPS) Coordinates**

Criteria: All processed GPS coordinate-related measurement data associated with annually scheduled statewide collection segments shall pass through the MDOT review & acceptance process as defined in this Scope of Services.

Payment: After MDOT determines criteria are met by Vendor, one single payment (in dollars) will be made per year. The payment amount will be the calculated product of the annual statewide mileage specified\*\*\* (estimated in Attachment D - Item 2E) and the Vendor's bid unit price per mile for GPS coordinate data. There will be four separate payments of this type over the life of the contract.

**F) Surface Distress Survey Data**

Criteria: All surface distress survey data shall pass through the MDOT review & acceptance process as defined in this Scope of Services.

Payment: Payment will be made on a milestone basis as follows:

Milestone 1: 50% of the unit price per mile for distress survey data will be paid for each LocID passing initial logic check.

Milestone 2: 35% of the unit price per mile for distress survey data will be paid for each LocID passing survey call quality level check.

Milestone 3: 15% of the unit price per mile for distress survey data will be paid for each LocID within a region when all LocIDs within the region have passed both initial logic check and survey call quality level check.

After MDOT determines that milestone criteria are met by Vendor for each yearly-indicated LocID's distress survey data, payment (in dollars) will be made per LocID mileage, per milestone. The payment amount will be the calculated product of the LocID mileage specified\*\*\* to have Vendor surveying performed (total yearly estimates in Attachment D – Items 2F1 & 2F2) and the milestone percentage of the Vendor's bid unit price per mile for either "surface distress survey data – 100% sample rate" or "surface distress survey data – 30% sample rate". Determination of the utilized bid unit price will depend upon MDOT's decision to execute Option F1 or F2 (as described elsewhere in this Scope).

**G) Software-Detected/Quantified Surface Cracking Data**

Criteria: All processed software-detected/quantified surface cracking data associated with the specific Year 2012 collection segments scheduled for such by MDOT shall be determined by MDOT review to have sufficiently met the associated criteria defined in Section B.2.8. of this Scope of Services.

Payment: After MDOT determines criteria are met by the Vendor, one single payment (in dollars) will be made. The payment amount will be the calculated product of the associated Year 2012 mileage specified\*\*\* (estimated in Attachment D - Item 2G) and the Vendor's bid unit price per mile for software-detected/quantified surface cracking data. There will be one payment of this type over the life of the contract.

**H) Grade and Curvature Data**

Criteria: All processed Grade and Curvature data associated with annually scheduled statewide collection segments shall pass through the MDOT review & acceptance process as defined in this Scope of Services.

Payment: After MDOT determines criteria are met by the Vendor, one single payment (in dollars) will be made per year. The payment amount will be the calculated product of the annual statewide mileage specified\*\*\* (estimated in Attachment D - Item 2H) and the Vendor's bid unit price per mile for Grade and Curvature Data. There will be four separate payments of this type over the life of the contract.

**3. Software for MDOT Data Quality Assurance and Management**

Criteria: All Vendor software to facilitate MDOT data QA and management functions shall be received, reviewed, and accepted by MDOT.

Payment: After MDOT determines criteria are met by Vendor, the first year's (2012's) annual payment (in dollars) will be made in the amount equal to the Vendor's associated bid price per year (Attachment D – Item 3). Subsequent single annual payments of the same amount will be made at the beginning of collection within the three remaining years.

4. **Hardware for MDOT Data Quality Assurance and Management**

Criteria: All Vendor hardware to facilitate MDOT data QA and management functions shall be received, reviewed, and accepted by MDOT.

Payment: After MDOT determines criteria are met by Vendor, the first year's (2012's) annual payment (in dollars) will be made in the amount equal to the Vendor's associated bid price per year (Attachment D – Item 4). Subsequent single annual payments of the same amount will be made at the beginning of collection within the three remaining years, unless MDOT chooses to remove this service Item from the contract.

5. **Internet Managed Hosting Service for MDOT-wide PhotoLog**

Criteria: The Vendor's hosted service site shall be found by MDOT review to be in-place, operational, providing all functionality required within this Scope document, and providing proper access to the entire first year's (2012's) statewide image set.

Payment: After MDOT determines criteria are met by Vendor, the first year's (2012's) annual payment (in dollars) will be made in the amount equal to the Vendor's associated bid price per year (Attachment D – Item 5). Subsequent single annual payments of the same amount will be made upon access being provided to each year's statewide image set within the three remaining years, unless MDOT chooses to remove this service Item from the contract.

\*\*\* Pavement segment mileages used for payment basis will be those defined within the MDOT network linear location referencing system and provided to the Vendor prior to each year's collection.

**ATTACHMENT F**

**MDOT  
PAVEMENT MANAGEMENT SYSTEM**

**FILE FORMATS**

**OF**

**LOCATION REFERENCING, DISTRESS, AND SENSOR DATA**

**FOR**

**PAVEMENT CONDITION MONITORING UTILIZING VEHICLE-COLLECTED SURFACE  
IMAGES & LASER MEASURES  
(2012 - 2015 Data Collection)**

**Updated July, 2011: DJS, C&T Pavement Management Section**

This document specifies the data formats for the MDOT-provided **TapeLog**, **Distress Survey Locations for Pay Item 2 - Option F2**, and **Pavement Type Locations & Rut/Fault Data Specification** files, as well as the **Vendor Data Collection Log**, **Distress Survey Data**, **Image-Distance**, and **Sensor Data/Grade/Curvature** files to be submitted by the Vendor for pavement measurement/imaging collection & processing. Throughout this document, the terms “**film**” and “**videotape**” are used interchangeably and have the same meaning as taking images on pavements by an acceptable video image taking method, including **digital imaging**.

The **TapeLog** file contains key identifications of each pavement section to be collected. This file will be provided by **MDOT** to the vendor and discussed in Section I of this document.

The **Distress Survey Locations for Pay Item 2 – Option F2** file defines the specific mileage range locations within each specified pavement segment to receive surface distress surveying where the Vendor shall actually perform the surveying if MDOT selects Option F2 (a network sampling approach).

The **Pavement Type Locations & Rut/Fault Data Specification** file defines the mileage ranges of pavement types within each pavement segment to be collected and whether or not wheelpath rut and and/or crack/joint fault data are to be provided by the Vendor.

The **Vendor Data Collection Log** links MDOT’s **TapeLog** file’s location referencing data to the actual measurement and imaging data Set/Timecode based referencing created during collected in the field. This file will be discussed in Section IV of this document.

The **Distress Survey Data** are obtained from digital images according to the **MDOT Distress Manual for Surveying of Pavement Surface Images**. These data shall be delivered to MDOT by the Vendor. The details of these data will be discussed in Section V of this document.

The **Image-Distance** data are to be created by the Vendor during collection, logging accumulated distance against elapsed time. These data shall be delivered to MDOT by the Vendor. The details of these data will be discussed in Section V of this document.

The (laser) **Sensor Data** related to pavement surface profile are obtained from rapid travel inertial profiler and gyroscope measurements according to the applicable AASHTO standard specifications. Corresponding summary data formats shall be as provided in Section VI of this document.

To facilitate later discussions on the above subjects, the Location Identification system of the Trunkline pavements of **MDOT** is briefly introduced here.

When a non-divided pavement section (two-way traffic) or a pair of divided pavement sections (one-way traffic) is constructed, a 5-digit number such as 02011 is assigned to the constructed pavement section(s). This number is termed as the **Control Section Number (CSN)** of a constructed pavement section. A linear and increasing milepost system is used to assign mileposts to a constructed pavement section according to the construction direction. Although the starting milepost is typically zero, it can be any

positive number. These mileposts are termed as the **CS Mileposts** of a constructed pavement section. The construction direction is defined as the **CS Direction** of a constructed pavement section. The end point with the lowest **CS Milepost** is defined as the **CS Beginning Point** of a constructed pavement section and the end point with the highest **CS Milepost** is defined as the **CS Ending Point** of a constructed pavement section. Some of the interesting points are summarized below:

2. **CS Direction** and traffic direction may be opposite. Therefore, the **CS Beginning Point** and **CS Ending Point** may be the ending point and beginning point, respectively, in terms of traffic direction.
3. **CSN**, **CS Direction**, and **CS Mileposts** can not uniquely identify a pavement section.
4. **CS (Control Section)** and pavement section are often interchangeable terms.

Each pavement section is also assigned with a different identification number (**PRN or Physical Reference Number**) which has 7 digits. To prepare for MDOT's potential future conversion from **CSN** to **PRN**, two zeros are inserted at the front of a **CSN**. However, for the purpose of explanation within this document, the **expanded CSN** will still be referred to simply as **CSN**.

A **Route** may be composed of multiple **Control Sections** and is assigned with a name such as I96. The **Route Direction** of a route is the majority of the traveling directions of its **CS** members. For a fully or partially divided **Route**, the two divided portions have opposite **Route Directions** such as EB and WB. For a non-divided **Route**, the **Route Direction** is either NB or EB. **Route Direction** is primarily used for administrative purpose only.

Two typical examples are presented below:

#### Example 1 : A Divided Route

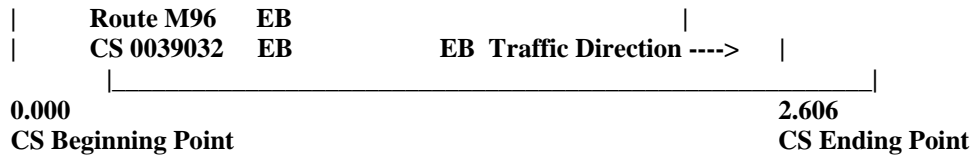
Route I375 WB		<---- WB Traffic Direction	
CS 0082111	EB		
3.222			4.001
CS Beginning Point			CS Ending Point

Route I375 EB		EB Traffic Direction ---->	
CS 0082111	EB		
3.044			4.001
CS Beginning Point			CS Ending Point

#### Example 2 : A Non-Divided Route

Route M96 EB		<----WB Traffic Direction
CS 0039032	EB	
-----		



In summary, a **CS** has the following attributes:

<b>ROUTE:</b>	Route Name	of Its Associated Route	
<b>ROUTE_DIR:</b>	Route Direction of Its Associated Route		(NB, SB, EB, WB)
<b>CSN:</b>	Control Section Number		(7-digit number)
<b>CS_DIR:</b>	CS Direction		(NB, SB, EB, WB)
<b>CS_BMP:</b>	CS Milepost of CS Beginning Point		
<b>CS_EMP:</b>	CS Milepost of CS Ending Point		

The videotaping vehicle must travel according to the traffic direction which may not agree with the **CS Direction** as shown in the above examples. To avoid confusion, the following terms are defined for videotaping and distress survey data processing purposes:

**Film\_DIR:** Traveling direction of the videotaping vehicle.

This will be referred to as the film or videotaping direction throughout this document.

**CS\_BMP\_Film:** CS milepost of the film beginning point (according to the direction specified by **Film\_DIR**) of a pavement section to be videotaped.

**CS\_EMP\_Film:** CS milepost of the film ending point (according to the direction specified by **Film\_DIR**) of a pavement section to be videotaped.

For the purpose of using shorter identification in the distress data processing, the following **Location ID (LOC\_ID)** is defined to uniquely define a pavement section to be videotaped:

**LOC\_ID** = <CSN><#1><#2><#3><#4>

where

<#1> = the first character of **CS\_DIR**  
 <#2> = the first character of **Route\_DIR**  
 <#3> = the first character of **Film\_DIR**

and

<#4> = 2-character code to ensure that **LOC\_ID** is a unique key for identifying a pavement section.

The typical convention for <#4> is as follows:

For any **CS** that belongs to a single route, the <#4> is 00. For a **CS** that is partitioned into several sections and each section belongs to a different route, <#4> is an unique positive number (within a **CS**) assigned to each section. Typically in such instances, <#4> will have the value of 01 assigned to the pavement section with the lowest **CS Milepost** numerical range; 02 assigned to the next highest **CS Milepost** range, etc.

The above **Location ID** for each pavement section to be videotaped is defined in MDOT **TapeLog** file. The vendor shall incorporate the provided **Location ID** into the detailed distress survey data files (to be explained later in this document).



## I. TapeLog File for Data Collection

This file contains information for each pavement section to be collected. This information is also needed for distress survey data record creation to be defined later in this document. This file will be provided by MDOT to the vendor prior to the collection sessions.

### File Format

Each record in this file defines a pavement section to be videotaped and has the following data fields:

<b>LOCID :</b>	Location ID
<b>ROUTE :</b>	Route name
<b>RTEDIR :</b>	Route direction
<b>CS_PR:</b>	Control Section Number / Physical Reference Number
<b>CSDIR:</b>	Control Section Direction
<b>FILMDIR:</b>	Collection Direction
<b>BMPFilm:</b>	Beginning CS milepost (per direction specified by Film_DIR)
<b>EMPFilm:</b>	Ending CS milepost (per direction specified by Film_DIR)
<b>LENGTH:</b>	Control Section length in miles
<b>REGION:</b>	Number designation of associated MDOT Region (1 through 7)
<b>START DESC:</b>	Descriptor of location where vehicle shall start filming
<b>END DESC:</b>	Descriptor of location where vehicle shall stop filming
<b>SUFFIX:</b>	Last two characters of LOCID
<b>COUNTY_NAME:</b>	Name of county this location lies within
<b>LANE:</b>	Collection lane designation
<b>DISTRESS:</b>	Distress survey data requirement ("True" or "False")
<b>IRI:</b>	Long. profile data (International Roughness) required ("True" or "False")
<b>RUT:</b>	Wheelpath rut data required ("True", "False", or "Partial")
<b>FAULT:</b>	Surface crack/joint fault data required ("True", "False", or "Partial")
<b>IMAGES:</b>	Forward perspective and downview requirement ("True" or "False")
<b>IMAGES2:</b>	Rear-facing perspective requirement ("True" or "False")
<b>Grad/Curv</b>	Grade & Curvature data required ("True" or "False")
<b>CollDir:</b>	"I" for Increasing CS mileage dir.; "D" for Decreasing CS mileage dir.
<b>Route Order:</b>	Numeric value which, when sorted along with REGION, ROUTE, and CollDir, can be utilized for collection organization sorting purposes.
<b>BMP_LAT:</b>	Latitude which corresponds to BMPfilm
<b>BMP_LONG:</b>	Longitude which corresponds to BMPfilm
<b>EMP_LAT:</b>	Latitude which corresponds to EMPfilm
<b>EMP_LONG:</b>	Longitude which corresponds to EMPfilm

### Example Record (Fictitious)

0082111EEEE00,I375,EB,0082111,EB,EB,3.044,4.001,0.957,7,175,Jnct.,MapleSt.,00,Wayne,1,T,T,F,T,T,F,T,D,1160,44.85  
871055,-83.42400432,45.06225655,-83.43338034

## II. Distress Survey Locations for Option F2 – Network Sampling

Upon MDOT's one-time choice to move from Option F1 to Option F2 (Refer to Section B.2.2. of this Scope document's main text and ATTACHMENT E), MDOT will provide the Vendor with an annual file listing of the specific mileage ranges within each LocID where network sample surveying (recording of distress type, extent, and severity) is to be performed. Mileage ranges specified for PD Code 909 (Not-Sampled Area) will not be included for distress survey data payment. The following is a format example of the file that would be provided:

### Example File Format for Distress Survey Data Option F2 - Location Sampling Directions

locid	BMPfilm	EMPfilm	Sub-Segment BMP	Sub-Segment EMP	Survey or Code909	length
0063103EEE01	0.659	1.466	0.659	0.679	Survey	0.02
			0.679	0.725	DoNotSurvey - Code909	0.046
			0.725	0.745	Survey	0.02
			0.745	0.791	DoNotSurvey - Code909	0.046
			0.791	0.811	Survey	0.02
			0.811	0.857	DoNotSurvey - Code909	0.046
			0.857	0.877	Survey	0.02
			0.877	0.923	DoNotSurvey - Code909	0.046
			0.923	0.943	Survey	0.02
			0.943	0.989	DoNotSurvey - Code909	0.046
			0.989	1.009	Survey	0.02
			1.009	1.055	DoNotSurvey - Code909	0.046
			1.055	1.075	Survey	0.02
			1.075	1.121	DoNotSurvey - Code909	0.046
			1.121	1.141	Survey	0.02
			1.141	1.187	DoNotSurvey - Code909	0.046
			1.187	1.207	Survey	0.02
			1.207	1.253	DoNotSurvey - Code909	0.046
			1.253	1.273	Survey	0.02
			1.273	1.319	DoNotSurvey - Code909	0.046
			1.319	1.339	Survey	0.02
			1.339	1.385	DoNotSurvey - Code909	0.046
			1.385	1.405	Survey	0.02
			1.405	1.451	DoNotSurvey - Code909	0.046
			1.451	1.466	Survey	0.015
0063103EEW01	1.469	0.637	1.469	1.489	Survey	0.02
			1.489	1.535	DoNotSurvey - Code909	0.046

**MDOT will provide for all Locations per each year's collection itinerary.**

### III. Pavement Type Locations and Rut/Fault Data Specification

The Vendor shall provide distress survey codes that are compatible with the MDOT-specified pavement type for a given LocID's mileage range. (See PD Code/Pavement Type compatibility definitions within ATTACHMENT G.) Additionally, laser measurement data for crack/joint faulting and wheelpath rutting will be required only on certain pavement types. The following file format is an example of the file that MDOT will provide annually to the Vendor defining such locations:

LOCATION_ID	PAVE_TYPE_CD	PAVE_TYPE_DESC	BMP	EMP	RUT	FAULT
0001051NNN00	3	COMPOSITE	0	6.194	TRUE	TRUE
0001051NNN00	2	FLEXIBLE	6.194	9.846	TRUE	FALSE
0001051NNN00	3	COMPOSITE	9.846	10.426	TRUE	TRUE
0001052NNN00	3	COMPOSITE	0	2.455	TRUE	TRUE
0001052NNN00	2	FLEXIBLE	2.455	3.743	TRUE	FALSE
0001052NNN00	3	COMPOSITE	3.743	11.778	TRUE	TRUE
0001052NNN00	2	FLEXIBLE	11.778	13.844	TRUE	FALSE
0001052NNN00	3	COMPOSITE	13.844	16.38	TRUE	TRUE
0002041EEE00	2	FLEXIBLE	0	22.549	TRUE	FALSE
0002041EEE00	1	RIGID	22.549	26.76	FALSE	TRUE
0002042EEE00	3	COMPOSITE	0	0.537	TRUE	TRUE
0002042EEE00	2	FLEXIBLE	0.537	0.836	TRUE	FALSE
0002042EEE00	3	COMPOSITE	0.836	1.204	TRUE	TRUE
0002042EEE00	2	FLEXIBLE	1.204	15.694	TRUE	FALSE
0003032NNN00	1	RIGID	0	2.013	FALSE	TRUE
0003032NNN00	3	COMPOSITE	2.013	4.197	TRUE	TRUE
0003032NNS00	3	COMPOSITE	4.159	2.29	TRUE	TRUE
0003032NNS00	1	RIGID	2.29	0	FALSE	TRUE
0003033NNN00	1	RIGID	0	9.37	FALSE	TRUE
0003033NNN00	3	COMPOSITE	9.37	12.453	TRUE	TRUE
0003033NNS00	3	COMPOSITE	12.454	9.37	TRUE	TRUE
0003033NNS00	1	RIGID	9.37	0	FALSE	TRUE
0003034NNN00	3	COMPOSITE	0	3.352	TRUE	TRUE
0003034NNN00	1	RIGID	3.352	10.573	FALSE	TRUE

## **IV. Vendor Data Collection Log**

The Vendor shall maintain and appropriately update a log relating the MDOT TapeLog information to corresponding data collected in the field. The log shall contain, verbatim, all data fields from the MDOT TapeLog along with, at least, the following:

- Date/time of collection
- Vendor-measured length of pavement segment to the nearest 0.001 mile
- Image Set identification
- Pavement Segment Beginning & Ending image IDs
- Pavement Segment Beginning & Ending GPS coordinates
- Corresponding distress survey data (filename) identification

## V. Distress Data Files And Their Companion Files

Pavement sections are to be surveyed from videotapes according to the **MDOT Distress Manual for Surveying of Pavement Surface Images** to identify distress conditions which are then processed into distress data according to the format specified in this section. The distress data of each pavement section are to be stored in a **Detailed Distress Survey Data file** and its companion, an **Offset-Distance file**. These files are defined below. Throughout this section, video frame and digital image are interchangeable.

### V-1. Offset-Distance (Image-Distance) Files

MDOT's system utilizes a 30-frame-per-second image collection scheme. The video images are stored in tape sets (one set containing multiple views for pavement surface and roadway perspective). Each set is assigned a unique 3-digit identification number (**Set ID**) that shall be unique per collection year. Each video frame in a tape set is labeled with a modified time stamp or **Timecode** (HH:MM:SS:##) that includes a **Frame Number** (01-30) per each second in the two rightmost fields (##). A video frame's **Timecode** is converted to its **Frame ID** for database use as follows:

$$\text{Frame ID} = (((\text{Hour} \times 3600) + (\text{Minute} \times 60) + \text{Second}) \times 30) + \text{Frame Number}$$

The conversion from **Frame ID** to **Timecode (Hour : Minute : Second : Frame Number)** is as follows:

$$\text{Hour} = \lfloor \text{Frame ID} / 108000 \rfloor$$

$$\text{Minute} = \lfloor (\text{Frame ID} - (\text{Hour} \times 108000)) / 1800 \rfloor$$

$$\text{Second} = \lfloor (\text{Frame ID} - (\text{Hour} \times 108000) - (\text{Minute} \times 1800)) / 30 \rfloor$$

$$\text{Frame Number} = \lfloor \text{Frame ID} - (\text{Hour} \times 108000) - (\text{Minute} \times 1800) - (\text{Second} \times 30) \rfloor$$

For example, a **Timecode** of 00:01:32:08 would have a corresponding **Frame ID** of 2768.

The vendor shall provide offset distance data of image frames according to the following file specifications:

The distance data of all video frames for a image set shall be stored in a file titled **ImageDis.<#>**, where <#> is the 3-digit image **Set ID**. This file will be referred to as a **Image-Distance** file.

Each record in this file shall have two fields (separated by a comma) as follows:

Field 1: Frame ID

Field 2: Distance (offset by inches)

The data in an **Image-Distance** file are used to compute mileposts and also for other applications.

## **V-2. Distress Survey Data Files**

Within each file, the distress survey data are stored in the order of film direction. Each record provides the data for pavement surface condition observed in a video frame by the vendor's surveyor and shall contain the following fields (separated by commas, ordered left to right):

### **LOCID (12 characters):**

The data value in this field is constant across all records in a single file and shall correspond to the MDOT-defined LOCID as provided in the TapeLog file.

### **Set\_ID (3 characters):**

The 3-digit tape **Set ID**. The data value in this field is constant across all records in a single file.

### **FID\_LOCID\_START (6 characters max):**

Frame ID which corresponds to the beginning descriptor for a given LOCID. The data value in this field is constant across all records in a single file.

### **FID\_LOCID\_END (6 characters max):**

Frame ID which corresponds to the ending descriptor for a given LOCID. The data value in this field is constant across all records in a single file.

### **CS\_BMP\_Frame (6 characters max):**

CS Milepost corresponding to the beginning video frame number used to define pavement distress condition in this record.

### **CS\_EMP\_Frame (6 characters max):**

CS Milepost corresponding to the ending video frame number used to define pavement distress condition in this record.

### **Film\_Date (8 characters):**

Date of field image collection.

**Survey\_Lane\_Number (1 character):**

Numbered designation of the lane in which this distress condition is observed.

The lane number is 1 for the far right (traffic/truck) thru lane and increases for each adjacent lane to the left (in the direction of filming).

**PD\_Code (4 characters, including a leading zero):**

Code of a principal distress condition.

This code is defined in the **MDOT Distress Manual for Surveying of Pavement Surface Images**.

**AD1\_SL\_Index**

**AD2\_SL\_Index (2 characters max each):**

Indices of severity level of **AD (Associated Distress)**

These two indices define severity and/or extent of a principal distress condition based on the corresponding Associated Distress matrix . Note that a value of **-1** is used to indicate “not applicable”. The details are defined in the **MDOT Distress Manual for Surveying of Pavement Surface Images**.

**AD\_Type\_Index (2 characters max) :**

This is the index of the associated distress type. A value of **-1** is used to indicate “not applicable”. The details are defined in the **MDOT Distress Manual for Surveying of Pavement Surface Images**.

**FID\_RECORD\_START (6 characters max):**

Frame ID of the beginning video image used to define pavement distress condition in this record.

**FID\_RECORD\_END (6 characters max):**

Frame ID of the ending video image used to define pavement distress condition in this record.

The data records in this file must be organized in the order of the videotaping direction. For the transverse-oriented distresses, each principal distress in a video survey frame must be recorded one-per-record. However, for the longitudinal-oriented distresses, a continuous distress such as Alligator Crack

with the same associated distresses may be recorded as one record.

The naming convention for a detailed distress survey data file is **<main title>.<file extension>** where **<main title>** is the first 8 characters of the **LOC\_ID** and **<file extension>** is the last 3 characters of the **LOC\_ID**.

Sample records of a detailed distress data file are shown below:

```
0060022EEE00,146,52172,69855,2.433,2.433,10302000,1,0103,2,1,-1,56615,56615
0060022EEE00,146,52172,69855,2.434,2.434,10302000,1,0809,-1,-1,-1,56617,56617
0060022EEE00,146,52172,69855,2.439,2.439,10302000,1,0809,-1,-1,-1,56630,56630
0060022EEE00,146,52172,69855,2.439,2.439,10302000,1,0113,2,1,1,56630,56630
0060022EEE00,146,52172,69855,3.083,3.083,10302000,1,0809,-1,-1,-1,57763,57763
0060022EEE00,146,52172,69855,3.083,3.102,10302000,1,0208,2,-1,8,57763,57794
0060022EEE00,146,52172,69855,3.085,3.085,10302000,1,0113,7,5,8,57765,57765
0060022EEE00,146,52172,69855,3.085,3.085,10302000,1,0113,1,1,8,57766,57766
0060022EEE00,146,52172,69855,3.085,3.089,10302000,1,0230,1,-1,7,57766,57772
0060022EEE00,146,52172,69855,3.086,3.086,10302000,1,0113,5,2,3,57768,57768
0060022EEE00,146,52172,69855,3.088,3.088,10302000,1,0113,6,3,3,57771,57771
0060022EEE00,146,52172,69855,3.090,3.093,10302000,1,0230,1,-1,7,57774,57779
0060022EEE00,146,52172,69855,3.094,3.094,10302000,1,0113,2,1,8,57781,57781
0060022EEE00,146,52172,69855,3.095,3.095,10302000,1,0113,2,1,8,57783,57783
0060022EEE00,146,52172,69855,3.096,3.096,10302000,1,0113,4,1,8,57784,57784
0060022EEE00,146,52172,69855,3.098,3.098,10302000,1,0113,6,4,8,57787,57787
0060022EEE00,146,52172,69855,3.100,3.100,10302000,1,0113,4,1,8,57790,57790
0060022EEE00,146,52172,69855,3.102,3.102,10302000,1,0809,-1,-1,-1,57794,57794
0060022EEE00,146,52172,69855,6.957,6.957,10302000,1,0114,-1,-1,-1,64061,64061
```



## **VI. Laser-Sensor & Gyroscope Measures Summary File Formats**

The following pages contain specifications of the three individual summary file layouts for the laser and gyroscope sensor data types to be submitted by the Vendor. Each file's data records shall be in comma-delimited ASCII format without tab or space characters. A single file shall be submitted per each MDOT Region for each of the three report types.

## **IRI / FAULTING / RUTTING / GRADE\***

Attributes	Example data	Definition
Locid	0009111NNN00	The alpha-numeric twelve character unique identifier per 1/10 mile segment
CS	0009111	The numeric seven-digit control section number per 1/10 mile segment
D	I	The alpha single-character control section mileage direction for a segment. Values entered in this field are I (increasing) or D (decreasing).
Start-Mi	0.000	The numeric beginning mile point for segment.
End-Mi	0.100	The numeric ending mile point for segment.
Set	111	The numeric tape set associated with this segment
BegFrameID	12345	The numeric beginning frameID for a segment
EndFrameID	67890	The numeric ending frameID for a segment
SurveyDateTime	04/07/2004 12:04	Numeric collection date & time for a segment.
Region	4	Region number for a segment
StaLatitude	+43.6126442	GPS latitude for the beginning of the given record.
StaLongitude	-83.9473419	GPS longitude for the beginning of the given record.
EndLatitude	+43.6140938	GPS latitude for the ending of the given record.
EndLongitude	-83.9472427	GPS longitude for the ending of the given record.
AvgSp	55.0	Average speed (MPH) the collection vehicle was traveling for the given record.
Stops	0	Number of occurrences the collection vehicle stopped for the given record.
Bridge	0	Number of bridge decks the collection vehicle passed over for the given record.
RR	0	Number of railroad crossings the collection vehicle passed over for the given record.
Constr	0	Number of construction zones collection vehicle encountered for the segment
Detour	0	Number of detours collection vehicle encountered for the segment
L1	1	Percent of segment length spent in Lane #1.
NotL1	0	Percent of segment length spent in other lanes.
Slow1	0	Collection vehicle speed fell below 15 MPH one or more times for the segment (value shall be 1 for true and 0 for false)
Slow2	0	Percent of segment length collection vehicle speed was less than 15 MPH
Temp	56	Average pavement surface temperature for Segment (°F)
IRILi/m	69	IRI Average (inches per mile) in Left Wheelpath for Segment
IRIRi/m	82	IRI Average (inches per mile) in Right Wheelpath for Segment
IRIAvg	75	IRI Average of Left and Right Wheelpath Averages for Segment
FAULnum	7	Number of Faults Detected per 1/10-Mile Segment (Rigid & Composite Pavements Only)
FAULi	0.06	Average Fault Value Detected in Segment (in.) (Rigid & Composite Pavements Only)
RUTLi	0.04	Average Rut Value in Left Wheelpath for Segment Length (in.) (Flexible and Composite Pavements Only)
MaxLi	0.07	Maximum Rut Value in Left Wheelpath for Segment Length(in.) (Flexible and Composite Pavements Only)
RUTRi	0.07	Average Rut Value in Right Wheelpath for Segment Length (in.) (Flexible and Composite Pavements Only)
MaxRi	0.15	Maximum Rut Value in Right Wheelpath for Segment Length(in.) (Flexible and Composite Pavements Only)

Attributes	Example data	Definition
RutAvg	0.05	Ave. Rut Value of Left and Right Wheelpath Averages for Segment Length (in.) (Flexible and Composite Pavements Only)
Heading (degrees)	241	(or Azimuth) - The average horizontal angle of the vehicle's directional bearing (measured clockwise from due North) for segment length
Grade (+/- %)	3.03	Average long. grade of surface (in travel direction) for segment length
Cross Slope (+/- %)	-1.34	Average transverse grade of survey lane pavement surface (measured left-to-right while facing direction of travel) for segment length

\*Note: Individual data measurement or statistic record cells (location referencing cells excluded) for mileage ranges that MDOT has directed to be marked as “Not Surveyed” (due to construction, detour, non-applicable pavement type, etc.) shall be left blank.

## VERTICAL CURVATURE

Attributes	Example data	Definition
locid	0009111NNN00	The alpha-numeric twelve character unique identifier
CS	0009111	The numeric seven-digit control section number
D	I	The alpha single-character control section mileage direction. Values entered in this field are I (increasing) or D (decreasing).
Start-Mi	1.678	The numeric beginning mile point for the curvature feature
End-Mi	1.843	The numeric ending mile point for the curvature feature
Set	111	The numeric tape set associated with this segment
BegFrameID	12345	The numeric beginning frameID of the Set for the curvature feature
EndFrameID	67890	The numeric ending frameID of the Set for the curvature feature
SurveyDateTime	04/07/2004 12:04	Numeric collection date & time
region	4	Region number
StaLatitude	+43.6126442	GPS latitude for the beginning of the curvature feature
StaLongitude	-83.9473419	GPS longitude for the beginning of the curvature feature
EndLatitude	+43.6140938	GPS latitude for the ending of the curvature feature
EndLongitude	-83.9472427	GPS longitude for the ending of the curvature feature
AlignFeatureType	Crest	Populate with either vertical angle point, sag, crest, or gradient
K factor ( ft / % )	262	Rate of vertical curvature, in English units
Length (ft)	869	Length of Feature
Gradient Percent (+/- %)	-2.06	For gradient feature type only

## HORIZONTAL CURVATURE

Attributes	Example data	Definition
locid	0009111NNN00	The alpha-numeric twelve character unique identifier
CS	0009111	The numeric seven-digit control section number
D	I	The alpha single-character control section mileage direction. Values entered in this field are I (increasing) or D (decreasing).
Start-Mi	0.000	The numeric beginning mile point for the curvature feature
End-Mi	0.100	The numeric ending mile point for the curvature feature
Set	111	The numeric tape set associated with this segment
BegFrameID	12345	The numeric beginning frameID for the curvature feature
EndFrameID	67890	The numeric ending frameID for the curvature feature
SurveyDateTime	04/07/2004 12:04	Numeric collection date & time
region	4	Region number
StaLatitude	+43.6126442	GPS latitude for the beginning of the curvature feature
StaLongitude	-83.9473419	GPS longitude for the beginning of the curvature feature
EndLatitude	+43.6140938	GPS latitude for the ending of the curvature feature
EndLongitude	-83.9472427	GPS longitude for the ending of the curvature feature
AlignFeatureType	Ind Curve	Populate with either angle point, independent curve, component of compound curve, component of reverse curve, or tangent section
Radius (ft.)	7202	Radius of curve
Degree	2.50	Degree of curvature (per 100-ft chord length)
Length (ft.)	1820	Length of feature
MaxSuperElev (+/- %)	6.8	Maximum transverse grade of survey lane pavement surface (measured left-to-right while facing direction of travel) measured within length of curve
SpiralTrans	N	Existence of spiral transitions between entrance/exit tangents and curve (Y or N)
Deflection Angle	25.6	Alignment deflection measured in degrees
Deflection Direction	L	Feature's alignment deflection with respect to direction of travel (L or R)

**ATTACHMENT G**

**MDOT  
PAVEMENT MANAGEMENT SYSTEM  
DISTRESS MANUAL**

**FOR SURVEYING  
OF  
PAVEMENT SURFACE IMAGES**

**(2012 - 2015 Data Collection)**

**Prepared by Pavement Management Unit  
Construction & Technology Area**

**(July, 2011)**

This document describes the **Michigan Department of Transportation's (MDOT's)** surface distress type definitions and survey methods. MDOT collects surface images on one half of its trunk-line pavement network every year. The images are displayed on a computer screen by a Distress Survey program. Throughout this document, a computer screen of pavement surface images is referred to as a **Survey Screen**. The pavement surface distresses on a survey screen are observed and recorded by type, extent, and severity through a Distress Survey software. These data are called **Distress Survey Data**.

Distresses can be classified into two categories which are primary and secondary distresses. Throughout this document, a primary distress is called a **Principal Distress**. For most of the **Principal Distresses**, the secondary distresses around a **Principal Distress** are also observed and recorded. The secondary distresses are called the **Associated Distresses** of a **Principal Distress** and are usually measured by the length and width of their surface area. The **Associated Distresses** are used to estimate the severity level and/or extent of a **Principal Distress** and are also used in many applications for estimating fix costs and determining causes of pavement deteriorations. **Associated Distress** type is important information for analyzing causes of pavement deteriorations. Therefore, **Associated Distress** type is also recorded in certain instances.

The following abbreviations are used throughout this document and other PMS documents:

<b>MDOT:</b>	<b>Michigan Department of Transportation</b>
<b>PMS :</b>	<b>Pavement Management System</b>
<b>PD :</b>	<b>Principal Distress</b>
<b>PDs :</b>	<b>Principal Distresses</b>
<b>AD :</b>	<b>Associated Distress</b>
<b>ADs :</b>	<b>Associated Distresses</b>

This document provides a list of **PDs** to be recorded by the **PMS** of **MDOT**. For each **PD**, the following items are defined:

## **1. Title And Code**

Each **PD** has a title and a unique 4-digit code. As an example, **Partial Width Patch (w)** designates the title of a **PD** that is assigned with a code **0326**. Throughout this and other **PMS** documents, the notation **PD<code #>** designates a **PD** identified by code **<code #>**. For the above example, **PD0326** designates **Partial Width Patch (w)**.

## **2. Definition**

This defines the properties or qualifications of a **PD**.

## **3. Survey**

This defines the method used to record a **PD** in a survey screen.

#### **4. Severity / Extent**

This defines the criteria for estimating the condition, severity and extent of a **PD** on a survey screen. Extent usually is the width of a distress area in the transverse direction and can be considered as a severity level of a **PD**. Thus, severity and extent are often interchangeable.

For a longitudinal-oriented **PD**, the extent in the longitudinal direction is the **PD**'s length. This length can be computed directly from the location/linear referencing numbers used to identify the survey screens that enclose the **PD**. For this reason, the extent in the longitudinal direction will not be mentioned in this subject.

#### **5. Associated Distress Matrix**

This defines what **ADs** of a **PD** are to be recorded.

Each **PD** can have at most two **ADs** that are used to measure the severity level and extent of the **PD**. An **AD** consists of a title and several items for measuring **PD** severity (or extent). These items are referred to as distress severities. Two **ADs** of **PD0326** are presented below for demonstration purposes:

##### **The First AD of PD0326:**

This **AD** is shown below in table format. The title of this **AD** is **Transverse Length**, shown as the table header. This **AD** has 5 rows, each is the range of patch width in the transverse direction. Thus, this **AD** measures the extent of this **PD** in the transverse direction. However, the extent in the longitudinal direction can be also considered as severity of this **PD** because it indirectly indicates the range of distress area.

<b>TRANSVERSE LENGTH</b>
<i>0 - 2 ft.</i>
<i>&gt; 2 - 4 ft.</i>
<i>&gt; 4 - 6 ft.</i>
<i>&gt; 6 - 8 ft.</i>
<i>&gt; 8 &lt; 12 ft.</i>

##### **The Second AD of PD0326:**

This **AD** is shown below in table format. The title of this **AD** is **CONDITION**, shown as the table header. This **AD** has 3 rows; each is a condition rating of the pavement within a patch. Thus, this **AD** measures the condition level of the **PD**.



CONDITION
<i>GOOD</i>
<i>FAIR</i>
<i>POOR</i>

The above two **ADs** of **PD0326** are combined into the following 2-dimensional table:

TRANSVERSE LENGTH	CONDITION		
	<i>GOOD</i>	<i>FAIR</i>	<i>POOR</i>
<i>0 - 2 ft.</i>			
<i>&gt;2 - 4 ft.</i>			
<i>&gt;4 - 6 ft.</i>			
<i>&gt;6 - 8 ft.</i>			
<i>&gt;8 &lt; 12 ft.</i>			

The above 2-dimensional table is referred to as the **AD Matrix** of **PD0326**. When a **Partial Width Patch (w)** is identified, the surveyor must determine to which cell of the above **AD Matrix** the associated distresses belongs. The **Code** of this **PD** along with the **row** and **column** numbers of the identified cell are recorded into a data file. (For data file format, see both the last section of this document entitled “**Format Layout of Condition-Specific Data Within a Distress Survey File**” and the separate document, **File Formats of Location Referencing, Distress, and Sensor Data**) As an example, for a **Partial Width Patch (w)** that is 5 feet wide (in the transverse direction) and is in fair condition, **0326** is recorded as **PD** and **(3 , 2)** is recorded as its associated distresses. As mentioned previously, the extent of this **PD** in the longitudinal direction is the linear referencing length enclosing this **PD** and, therefore, is not part of the **AD Matrix**. The above explanations are applied to any **PD** that has a 2-dimensional **AD Matrix**.

Not every **PD** has two **ADs**. As an example, **PD0341 (Delaminated Area)** has only one AD as shown below:

TRANSVERSE LENGTH
<i>&gt;0 - 2 ft.</i>
<i>&gt;2 - 3 ft.</i>
<i>&gt;3 - 6 ft.</i>
<i>&gt;6 - 8 ft.</i>
<i>&gt;8 - 12 ft.</i>

The above **AD** is also referred to as the **AD Matrix** of **PD0341**. This AD Matrix measures the

extent (also severity) of this **PD** in the transverse direction, which is shown as the matrix title.

When a **Delaminated area** is identified, the surveyor must determine to which cell of the above **AD Matrix** the associated distress belongs. The Code of this **PD** along with the row number of the identified cell is recorded into a data file. As an example, for a **Delaminated area** that can be enclosed by a rectangle of width **7** feet in the transverse direction, **0341** is recorded as the **PD<code #>** and **(4, -1)** is recorded as its associated distress. The number **-1** is used to indicate that this **PD** has only one **AD**. The above explanations are applied to any **PD** that has only one **AD**.

Some **PDs** do not have an **AD**. As an example, **PD0405 (Raveling)** is to have **0405** recorded as its **PD<code #>** and **(-1, -1)** recorded as its associated distress. **(-1,-1)** means that the **PD** does not have an **AD**. The above explanations are applied to any **PD** that does not have an **AD**.

## **6. ASSOCIATED DISTRESS TYPE**

Some **PDs** require that a corresponding associated distress type be recorded. Similar to **AD** matrices, MDOT's system has three distinct **AD Type Tables** (displayed below and identified by unique code numbers – referenced later in this document) with each containing multiple AD Type descriptions from which a single one is selected per each **PD**.

### **AD 0083:**

ASSOCIATED DISTRESS TYPE
Punched Area
None of Above

### **AD 0082:**

ASSOCIATED DISTRESS TYPE
Associated Cracking
Irregular Surface
None of Above

### **AD 0081:**

ASSOCIATED DISTRESS TYPE
D-Cracked

<b>Map Cracking</b>
<b>Spalled</b>
<b>High Steel</b>
<b>Punch Out</b>
<b>Corner Crack</b>
<b>Delamination</b>
<b>None of Above</b>

**Remark:** This Table revised from document used for 2000-2005 surveys by replacing “Reactive Aggregate” with “Map Cracking”.

If **AD Type** identification is required for a **PD**, the surveyor shall utilize the appropriate **AD Table** above (as specified later in this document) and determine the proper cell of the Table to which the observed **AD Type** description belongs. The row number of the identified cell is recorded as **AD Type**. When multiple types of **AD** are observed, the surveyor shall record only the one that is present in the majority.

The data to be recorded for a **PD** are summarized below:

- (1) **PD Code**
- (2) Row Number of AD Matrix (-1 for not applicable)
- (3) Column Number of AD Matrix (-1 for not applicable)
- (4) Row Number of AD Type (-1 for not applicable)
- (5) ID used to identify the survey screen that just encloses the beginning point of a **PD**  
(Or **AD** of a **PD**)
- (6a) for a transverse-oriented PD, this is the same as (5).
- (6b) for a longitudinal-oriented PD, this is the ID used to identify the survey screen that just misses the end point of a PD.

As previously mentioned, (5) and (6b) are used to compute the extent of a **PD** in the longitudinal direction (longitudinal length) through conversion to linear referencing units.

Before providing the detailed **PD** information, the **PDs** to be recorded are listed in **Table 1** for quick reference. Each row of this table has the following information for a **PD**:

<b>Column 1</b>	:	<b>PD Code</b>
<b>Column 2</b>	:	<b>PD Title</b>
<b>Column 3</b>	:	<b>Applicability of a PD to Rigid Pavement</b>
<b>Column 4</b>	:	<b>Applicability of a PD to Flexible Pavement</b>

**Column 5 : Applicability of a PD to Composite Pavement**  
**Column 6 : Applicability of a PD to CRC Pavement**

**TABLE 1**  
**PRINCIPAL DISTRESSES (PD)**  
**PD CODE, PD TITLE, AND APPLICABLE PAVEMENT TYPES**

PD CODE	PD TITLE	RIGID	FLEX.	COMP.	BRICK*
0103	TC (straight)	—	Yes	---	---
0104	TC (irregular)	—	Yes	---	---
0106	Transverse Joint	Yes	---	---	---
0110	TC	---	---	Yes	---
0112	TC (open > 1/4 in.)	Yes	---	---	---
0113	TC	Yes	---	---	---
0114	Transverse Tear	—	Yes	Yes	---
0201	LC - left edge	---	Yes	Yes	---
0202	LC - center of lane	---	Yes	Yes	---
0203	LC - right edge	---	Yes	Yes	---
0204	LC - right WP	---	Yes	Yes	---
0205	LC - left WP	---	Yes	Yes	---
0208	L. Joint - left	Yes	---	---	---
0209	L. Joint - right	Yes	---	---	---
0234	Alligator Crack - right WP	---	Yes	---	---
0235	Alligator Crack - left WP	---	Yes	---	---
0227	LC (> 1/4 in.) - right WP	Yes	---	---	---
0228	LC (> 1/4 in.) - c. of lane	Yes	---	---	---
0229	LC (> 1/4 in.) - left WP	Yes	---	---	---
0230	LC - right WP	Yes	---	---	---
0231	LC - center of lane	Yes	---	---	---
0232	LC - left WP	Yes	—	—	---
0326	Partial Width Patch (W)	Yes	Yes	Yes	---
0327	Partial Width Patch (b)	Yes	Yes	Yes	---
0341	Delaminated Area	Yes	---	---	---
0342	Map Cracking	Yes	---	---	---
0343	High Steel	Yes	---	---	---

<b>PD CODE</b>	<b>PD TITLE</b>	<b>RIGID</b>	<b>FLEX.</b>	<b>COMP.</b>	<b>BRICK*</b>
<b>0344</b>	<b>Shattered Area</b>	<b>Yes</b>	<b>---</b>		<b>---</b>
<b>0345</b>	<b>Block Cracking</b>	<b>---</b>	<b>Yes</b>	<b>---</b>	<b>---</b>
<b>0346</b>	<b>Refl. Shattered Area</b>	<b>---</b>	<b>---</b>	<b>Yes</b>	<b>---</b>
<b>0402</b>	<b>Popouts</b>	<b>Yes</b>	<b>---</b>	<b>---</b>	<b>---</b>
<b>0403</b>	<b>Scaling</b>	<b>Yes</b>	<b>---</b>	<b>---</b>	<b>---</b>
<b>0405</b>	<b>Raveling</b>	<b>---</b>	<b>Yes</b>	<b>Yes</b>	<b>---</b>
<b>0406</b>	<b>Flushing</b>	<b>---</b>	<b>Yes</b>	<b>Yes</b>	<b>---</b>
<b>0501</b>	<b>No-Distress Area</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>---</b>
<b>0809**</b>	<b>New Pavement Type</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>
<b>0908**</b>	<b>Not Surveyed</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>
<b>0909**</b>	<b>Not-Sampled Area</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>

\* Any/all brick pavement observed in images during survey shall be recorded as PD 0908 – “Not Surveyed”.

\*\* PD Codes 0809, 0908, and 0909 shall be placed within data for locations specified by MDOT, with the exception of brick pavement locations as noted above.

**PRINCIPAL DISTRESSES**  
**UNDER**  
**THE CURRENT MDOT SURVEY SYSTEM**

## TRANSVERSE JOINT - PD0106

(Rigid & CRC Pavements)

### DEFINITION:

A **Transverse Joint (TJ)** is a regularly spaced saw cut which has been sealed across the slab width.

The usual spacing between two **Transverse Joints** is 15, 27, 44, 72, or 99 feet. Note that **Transverse Joints** in **CRCP** may occur at occasional intervals around bridges.

### SURVEY:

A **TJ** that has no associated distress shall not be recorded.

Record every observable **TJ** that has associated distress unless the pavement location can be identified as a **Shattered Area (PD0344)**. In the case of intersecting transverse and longitudinal cracks and/or joints, an area of associated distress that may be identified with either the longitudinal or transverse PD shall be recorded for only one of PD per location.

### SEVERITY / EXTENT:

The severity of a **Transverse Joint** is estimated by **Transverse Length** and **Maximum Width** of the associated distresses that occurs within 4 feet of the joint.

### ASSOCIATED DISTRESS MATRIX: AD<sub>12</sub> 0001 x 0011

	MAXIMUM WIDTH				
TRANSVERSE LENGTH	No Distress	>0 - 1 ft.	>1 - 3 ft.	>3 - 6 ft.	>6 - 8 ft.
No Distress		xxxxxxx	xxxxxxx	Xxxxxxxx	xxxxxxx
>0 - 1 ft.	xxxxxxx				
>1 - 3 ft.	xxxxxxx				
>3 - 6 ft.	xxxxxxx				
>6 - 12 ft.	xxxxxxx				

*Note that cells marked with xxxxx are not applicable.*

### ASSOCIATED DISTRESS TYPE: AD<sub>4</sub> 0081



## **TRANSVERSE TEAR - PD0114**

**(Flexible & Composite Pavements)**

### **DEFINITION:**

A **Transverse Tear** is a transverse-oriented short crack (4" to ½ of lane width) that appears in any location across the survey lane.

Note that any such short crack shall not be qualified as a **Transverse Tear** if it can be claimed as **AD** of other **PDs** such as **TC**, **LC**, **Alligator Crack**, and **Block Cracking** for flexible pavement or **TC**, **LC**, and **Reflective Shattered Area** for composite pavement.

### **SURVEY:**

A **Transverse Tear** PD shall be recorded at locations where the above definition and constraints are observed. For a given mile point location (0.001 mile), if multiple unconnected **Transverse Tears** are present across the lane width (without presence of other PDs listed above), there shall be only one **Transverse Tear** record made for the mile point location.

**SEVERITY / EXTENT:** None

**ASSOCIATED DISTRESS MATRIX:** None

**ASSOCIATED DISTRESS TYPE:** None

**TC - PD0113 (Rigid & CRC Pavements)**  
**TC - PD0110 (Composite Pavement)**

**DEFINITION:**

**TC** stands for a **Transverse Crack** that meets the following criteria:

- (1) It extends more in the transverse direction than the longitudinal direction. That is, the angle between the overall crack line and the transverse line is less than 45 degrees.
- (2) It is visible for at least one half of the lane width.
- (3) For **Rigid** and **CRC** pavements, it is not opened up more than 1/4".

**SURVEY:**

Record every observable **TC** unless the pavement location can be identified as a **Shattered Area (PD0344)** for rigid/CRC pavement or **Refl. Shattered Area (PD0346)** for composite pavement.

**SEVERITY / EXTENT:**

The severity of a **TC** is estimated by **Transverse Length** and **Maximum Width** of the associated distresses that occur within 4 feet of the **TC**. In the case of intersecting transverse and longitudinal cracks and/or joints, an area of associated distress that may be identified with either the longitudinal or transverse PD shall be recorded for only one PD per location.

**ASSOCIATED DISTRESS MATRIX:** AD<sub>12</sub> 0004 x 0011

TRANSVERSE LENGTH	MAXIMUM WIDTH				
	No Distress	>0 - 1 ft.	>1 - 3 ft.	>3 - 6 ft.	>6 - 8 ft.
No Distress - No Seal		xxxxxxx	xxxxxxx	xxxxxxx	xxxxxxx
No Distress - Seal (full)		xxxxxxx	xxxxxxx	xxxxxxx	xxxxxxx
No Distress - Seal (part)		xxxxxxx	xxxxxxx	xxxxxxx	xxxxxxx
No Distress - Seal (open)		xxxxxxx	xxxxxxx	xxxxxxx	xxxxxxx
>0 - 1 ft.	Xxxxxxxx				
>1 - 3 ft.	Xxxxxxxx				
>3 - 6 ft.	Xxxxxxxx				
>6 - 12 ft.	Xxxxxxxx				

*Note that cells marked with xxxxx are not applicable.*

**ASSOCIATED DISTRESS TYPE:** AD<sub>4</sub> 0081 for PD0113 (Rigid & CRC pavements)  
None for PD0110 (Composite pavement)

**TC (straight) - PD0103**  
**TC (irregular) - PD0104**  
 (Flexible Pavement)

**DEFINITION:**

**TC** stands for a **Transverse Crack** that meets the following criteria:

- (1) It extends more in the transverse direction than the longitudinal direction. That is, the angle between the overall crack line and the transverse line is less than 45 degrees.
- (2) It must be visible for at least ½ of the lane width.
- (3) For **TC (straight)**, crack must be straight for entire length and not change direction.  
 For **TC (irregular)**, crack must change direction as it progresses across the lane.

**SURVEY:**

Record every observable **TC** unless the pavement area can be identified as a **Block Cracking (PD0345)**.

**SEVERITY / EXTENT:**

The severity of a **TC** is estimated by **Transverse Length & Maximum Width** of the **ADs** that occur within 2 feet of the **TC**. In the case of intersecting transverse and longitudinal cracks and/or joints, an area of associated distress that may be identified with either the longitudinal or transverse PD shall be recorded for only one PD per location.

**ASSOCIATED DISTRESS MATRIX:** AD<sub>12</sub> 0004 x 0012

TRANSVERSE LENGTH	MAXIMUM WIDTH			
	No Distress	>0 - 1 ft.	>1 - 2 ft.	>2 - 4 ft.
No Distress - No Seal		xxxxxxx	xxxxxxx	xxxxxxx
No Distress - Seal (full)		xxxxxxx	xxxxxxx	xxxxxxx
No Distress - Seal (part)		xxxxxxx	xxxxxxx	xxxxxxx
No Distress - Seal (open)		xxxxxxx	xxxxxxx	xxxxxxx
>0 - 1 ft.	xxxxxxx			
>1 - 3 ft.	xxxxxxx			
>3 - 6 ft.	xxxxxxx			
>6 - 12 ft.	xxxxxxx			

*Note that cells marked with xxxxx are not applicable.*

**ASSOCIATED DISTRESS TYPE:** None

**TC (open > 1/4 in.) - PD0112**  
(Rigid & CRC Pavements)

**DEFINITION:**

**TC (open>1/4 in.)** stands for a **Transverse Crack** that meets the following criteria:

- (1) It extends more in the transverse direction than the longitudinal direction. That is, the angle between the overall crack line and the transverse line is less than 45 degrees.
- (2) It is visible for at least one half of the lane width.
- (3) It is opened up at least 1/4 in.

**SURVEY:**

Record every observable **TC (open> 1/4 in.)** unless the pavement location can be identified as a **Shattered Area (PD0344)**.

**SEVERITY / EXTENT:**

The severity of a **TC (open> 1/4 in.)** is estimated by **Transverse Length** and **Maximum Width** of the associated distresses that occur within 4 feet of the TC. In the case of intersecting transverse and longitudinal cracks and/or joints, an area of associated distress that may be identified with either the longitudinal or transverse PD shall be recorded for only one PD per location.

**ASSOCIATED DISTRESS MATRIX:** AD<sub>12</sub> 0004 x 0011

	MAXIMUM WIDTH				
TRANSVERSE LENGTH	No Distress	>0 - 1 ft.	>1 - 3 ft.	>3 - 6 ft.	>6 - 8 ft.
No Distress - No Seal		xxxxxxx	xxxxxxx	xxxxxxx	xxxxxxx
No Distress - Seal (full)		xxxxxxx	xxxxxxx	xxxxxxx	xxxxxxx
No Distress - Seal (part)		xxxxxxx	xxxxxxx	xxxxxxx	xxxxxxx
No Distress - Seal (open)		xxxxxxx	xxxxxxx	xxxxxxx	xxxxxxx
>0 - 1 ft.	xxxxxxx				
>1 - 3 ft.	xxxxxxx				
>3 - 6 ft.	xxxxxxx				
>6 - 12 ft.	xxxxxxx				

*Note that cells marked with xxxxx are not applicable.*

**ASSOCIATED DISTRESS TYPE:** AD<sub>4</sub> 0081

**L. JOINT (right) - PD0209**  
**L. JOINT (left ) - PD0208**  
**(Rigid & CRC Pavements)**

**DEFINITION:**

**L. JOINT** stands for **Longitudinal Joint**. The above two **PDs** are the right and left **Longitudinal Joints**, respectively, of the survey lane.

A **Longitudinal Joint** is the sawed or formed joint between two lanes or between the pavement lane and shoulder.

**SURVEY:**

A **Longitudinal Joint** that has no associated distress shall not be recorded.

Record every observable **Longitudinal Joint** that has associated distress unless the pavement area can be identified as a **Shattered Area (PD0344)**.

**SEVERITY / EXTENT:**

The severity of a **Longitudinal Joint** is estimated by **Maximum Width** of the associated distresses that occur within 2 feet of the joint. In the case of intersecting transverse and longitudinal cracks and/or joints, an area of associated distress that may be identified with either the longitudinal or transverse PD shall be recorded for only one PD per location.

**ASSOCIATED DISTRESS MATRIX:** AD<sub>1</sub> 0012

MAXIMUM WIDTH
<i>No Distress</i>
<i>&gt;0 - 1 ft.</i>
<i>&gt;1 - 2 ft.</i>
<i>&gt;2 - 4 ft.</i>

**ASSOCIATED DISTRESS TYPE:** AD<sub>4</sub> 0081

<b>LC (right WP)</b>	<b>- PD0230</b>
<b>LC (center of lane)</b>	<b>- PD0231</b>
<b>LC (left WP)</b>	<b>- PD0232</b>
<b>LC &gt;1/4 in. (Right WP)</b>	<b>- PD0227</b>
<b>LC &gt;1/4 in. (C. of lane)</b>	<b>- PD0228</b>
<b>LC &gt;1/4 in. (Left WP )</b>	<b>- PD0229</b>
<b>(Rigid &amp; CRC Pavements)</b>	

### DEFINITION:

**LC** is a **Longitudinal Crack** and (**>1/4 in.**) means (**open > 1/4 in.**). Each of the above **PDs** is an **LC** in a location across the survey lane that meets the following criteria:

- (1) It extends more in the longitudinal direction than the transverse direction. That is, the angle between the overall crack line and the edge line is less than 45 degrees.
- (2) The crack is visible and continuous for at least 5 feet.
- (3) For **PD0230 - PD0232**, the crack is opened up **less than** 1/4 in.
- (4) For **PD0227 - PD0229**, the crack is opened up **at least** 1/4 in.

### SURVEY:

Record every observable **LC** unless pavement location can be identified as a **Shattered Area (PD0344)**. Note that each lane location can have at most one **LC** recorded.

### SEVERITY / EXTENT:

The severity of a **LC** is estimated by **Maximum Width** of the associated distresses that occur within 2 feet of the **LC**. In the case of intersecting transverse and longitudinal cracks and/or joints, an area of associated distress that may be identified with either the longitudinal or transverse PD shall be recorded for only one PD per location.

### ASSOCIATED DISTRESS MATRIX: AD<sub>1</sub> 0013

<b>MAXIMUM WIDTH</b>
<i>No Distress - No Seal</i>
<i>No Distress - Seal (full)</i>
<i>No Distress - Seal (part)</i>
<i>No Distress - Seal (open)</i>
<i>&gt;0 - 1 ft.</i>
<i>&gt;1 - 2 ft.</i>
<i>&gt;2 - 4 ft.</i>

### ASSOCIATED DISTRESS TYPE: AD<sub>4</sub> 0081

<b>LC (left edge)</b>	<b>-</b>	<b>PD0201</b>
<b>LC (left WP)</b>	<b>-</b>	<b>PD0205</b>
<b>LC (center of lane)</b>	<b>-</b>	<b>PD0202</b>
<b>LC (right WP)</b>	<b>-</b>	<b>PD0204</b>
<b>LC (right edge)</b>	<b>-</b>	<b>PD0203</b>
<b>(Flexible &amp; Composite Pavements)</b>		

### DEFINITION:

**LC** designates **Longitudinal Crack**. Each of the above PDs is an LC for a designated location across the survey lane that meets the following criteria:

- (1) It extends more the longitudinally than transversely. That is, the angle between the overall crack line and the edge line is less than 45 degrees.
- (2) The crack is visible and continuous for at least 5 feet.

### SURVEY:

Record every observable **LC** unless the pavement location can be identified as **Block Cracking (PD0345)** for flexible pavement or **Refl. Shattered Area (PD0346)** for composite pavement. Note that each lane location (right WP, left WP and centerline) can have at most one **LC** recorded, including those associated with **Alligator Crack (PDs 0234 and 0235)**, if it is flexible pavement.

### SEVERITY / EXTENT:

The severity of an **LC** is estimated by **Maximum Width** of the associated distresses that occur within 2 feet of the LC. In the case of intersecting transverse and longitudinal cracks and/or joints, an area of associated distress that may be identified with either the longitudinal or transverse PD shall be recorded for only one PD per location.

### ASSOCIATED DISTRESS MATRIX: AD<sub>1</sub> 0013

<b>MAXIMUM WIDTH</b>
<i>No Distress - No Seal</i>
<i>No Distress - Seal (full)</i>
<i>No Distress - Seal (part)</i>
<i>No Distress - Seal (open)</i>
<i>&gt;0 - 1 ft.</i>
<i>&gt;1 - 2 ft.</i>
<i>&gt;2 - 4 ft.</i>

### ASSOCIATED DISTRESS TYPE: None

**ALLIGATOR CRACKING (right WP) - PD0234**  
**ALLIGATOR CRACKING (left WP) - PD0235**  
**(Flexible Pavement)**

**DEFINITION:**

**Alligator Cracking** is two or more parallel longitudinal cracks (originating in a wheel path – WP) with transverse tears running between them, displaying a pattern similar to an alligator hide.

**Alligator Cracking** may extend laterally to other lane locations as severity increases.

**SURVEY:**

An **Alligator Cracking** PD shall be recorded when the defined condition above is visible for at least 5 feet longitudinally along the pavement unless the location meets the condition definition for **Block Cracking (PD0345)**. Each lane location (across the lane) may have at most one **LC** or **Alligator Cracking** record per longitudinal pavement location.

**SEVERITY / EXTENT:**

The severity of **Alligator Cracking** is estimated by the **Maximum Width** of all combined associated distresses occurring within 2 feet from the outermost of the parallel longitudinal cracks. Therefore, **Maximum Width** shall be at least the lateral distance between the two outermost longitudinal cracks (if all visible associated distresses are contained between them).

**ASSOCIATED DISTRESS MATRIX:** AD<sub>1</sub> 0016

MAXIMUM WIDTH
> 1 - 2 ft.
> 2 - 4 ft.
> 4 - 6 ft.

**ASSOCIATED DISTRESS TYPE:** None



<b>DELAMINATED AREA</b>	<b>- PD 0341</b>
<b>MAP CRACKING</b>	<b>- PD 0342</b>
<b>HIGH STEEL</b>	<b>- PD 0343</b>
<b>(Rigid &amp; CRC Pavements)</b>	

## **DEFINITION:**

A **Delaminated Area** is an area that has the following characteristics:

- (1) Pieces of concrete are broken out from the surface
- (2) The pattern usually begins in a circular shape
- (3) The depth must be at least 1" and may reach to the reinforcing steel.

A **Map Cracking** area is typically one with a honeycomb pattern of very tight cracks or intense short (0.5 - 1.0 ft) cracks.

A **High Steel** area shall have at least one of the following characteristics:

- (1) Missing concrete observed in the pattern of the reinforcing steel, or
- (2) Visible bare steel at the surface.

Note that any of the above PDs shall not be recorded at a given location if some other PD is observed. That is, if there is another observed PD at the same location, the location shall be recorded as that other PD, and the observed delaminated area, map cracked area, or high steel area shall instead be used to measure AD and AD Type (if required) for the other PD.

## **SURVEY:**

A pavement location shall be recorded as a **Delaminated Area**, **Map Cracking** area, or **High Steel** area when the respective definitions above are observed (again, if no other PDs are present).

Note that consecutive, uninterrupted locations observed as any of these three PDs that have the same severity level shall be combined and recorded as one continuous area.

Occasionally, a surveyor may have difficulty judging whether the pavement in a down view survey screen meets the above definitions. The perspective view image must be used in such cases to assist with a decision.

## **SEVERITY / EXTENT:**

The severity of these three **PDs** is estimated by the **Transverse Length** (width of the area in transverse direction) of the qualified area.

**DELAMINATED AREA**            - **PD 0341**  
**MAP CRACKING**                - **PD 0342**  
**HIGH STEEL**                    - **PD 0343**  
 (Rigid & CRC Pavements)

**ASSOCIATED DISTRESS MATRIX:**    AD<sub>1</sub>???? (Undefined yet for internal use)

TRANSVERSE LENGTH
>0 - 2 ft.
>2 - 3 ft.
>3 - 6 ft.
>6 - 8 ft.
>8 - 12 ft.

**ASSOCIATED DISTRESS TYPE:** None

## **SHATTERED AREA - PD0344**

**(Rigid & CRC Pavements)**

### **DEFINITION:**

A **Shattered Area** typically has a pattern of diagonal and/or looping cracks which may intersect some or all transverse joints/cracks and longitudinal joints/cracks. Typically this distress is caused by a lack of sub-grade support, and is characterized by a broken pattern of multiple individual pavement pieces which may be depressed in relation to the surrounding pavement surface.

### **SURVEY:**

A **Shattered Area** shall be recorded if observation of the pavement location meets the above definition.

Consecutive, uninterrupted pavement locations that meet this definition of a **Shattered Area** shall be combined and recorded as one **Shattered Area**.

Occasionally, a surveyor may have difficulty judging whether the pavement in a pavement down view survey screen meets the above definition. In such a case, the perspective view image must be utilized to assist with a decision.

Note that a pavement location cannot have any other PD recorded when a **Shattered Area** PD is identified.

**SEVERITY / EXTENT:** None

**ASSOCIATED DISTRESS MATRIX:** None

**ASSOCIATED DISTRESS TYPE:** AD<sub>4</sub> 0083

## **BLOCK CRACKING - PD0345**

**(Flexible Pavement)**

### **DEFINITION:**

A **Block Cracking** area is where transverse and longitudinal cracking have progressed to a point where blocks less than 12' by 12' in dimension are visible.

The shape of each block may be irregular because it depends on the form of the initial transverse cracking and later induced longitudinal cracking. Therefore, a pavement location shall also be considered as meeting the above definition if it is covered with long and/or short cracks and broken into irregular blocks.

### **SURVEY:**

A **Block Cracking** area shall be recorded if the pavement location meets the above definition and is broken into at least **6** blocks.

Consecutive, uninterrupted pavement locations identified as **Block Cracking** areas shall be combined and recorded as one continuous **Block Cracking** area.

Occasionally, a surveyor may have difficulty judging whether the pavement in a survey screen meets the above definition. In such a case, the perspective view image must be viewed to assist with a decision.

Note that a pavement location cannot have any other PD recorded when a Block Cracking PD is identified.

**SEVERITY:** None

**ASSOCIATED DISTRESS MATRIX:** None

**ASSOCIATED DISTRESS TYPE:** None

## **REFL. SHATTERED AREA - PD0346** **(Composite Pavement)**

### **DEFINITION:**

The above title stands for **REFLECTIVE SHATTERED AREA**.

This is an area of cracking that reflects a deteriorated area in the underlying concrete pavement. This area has a pattern ranging from small "Y" shaped tears to looping cracks that outline large broken pieces.

### **SURVEY:**

A **Reflective Shattered Area** shall be recorded for pavement locations that meet the above definition.

Consecutive, uninterrupted pavement locations that are identified as **Reflective Shattered Areas** shall be combined and recorded as one **Reflective Shattered Area**.

Occasionally, the surveyor may have difficulty judging whether or not a pavement location meets the above definitions from the down view image alone. In such a case, the surveyor must utilize the perspective view image to assist the decision.

Note that a pavement location cannot have any other PD recorded when a Reflective Shattered Area PD is identified.

**SEVERITY / EXTENT:** None

**ASSOCIATED DISTRESS MATRIX:** None

**ASSOCIATED DISTRESS TYPE:** None

## **POPOUTS - PD0402**

**(Rigid & CRC Pavements)**

### **DEFINITION:**

A **Popout** is a void in the pavement surface caused by soft material or aggregate absorbing water and then “popping” out of the concrete upon freezing. **Popouts** are typically less than 2” in diameter and resemble a small bowl-shaped depression or crater in the pavement surface.

### **SURVEY:**

A **Popouts** PD shall be recorded when an observed pavement location’s average number of **Popouts** per linear foot is one or more.

Consecutive, uninterrupted pavement locations that are identified as **Popouts** areas shall be combined and recorded as one continuous **Popouts** area.

Note that other observed PDs are to be recorded regardless of the presence of **Popouts**.

**SEVERITY / EXTENT:** None

**ASSOCIATED DISTRESS MATRIX:** None

**ASSOCIATED DISTRESS TYPE:** None

## **SCALING - PD0403**

**(Rigid & CRC Pavements)**

### **DEFINITION:**

An area of **Scaling** is one where the top (smooth finish) layer of concrete is separated and displaced from the aggregate, leaving aggregate exposed and creating a rough surface texture. In general, **Scaling** is caused by exposure, wear, over finishing of the mix, or too much water in the mix.

### **SURVEY:**

A **Scaling** PD shall be recorded when a pavement location has more than 50% of its area covered by the condition stated in the above definition.

Consecutive, uninterrupted pavement locations that are identified as **Scaling** areas shall be combined and recorded as one continuous **Scaling** area.

Note that other observed PDs are to be recorded regardless of the presence of **Scaling**.

**SEVERITY / EXTENT:** None

**ASSOCIATED DISTRESS MATRIX:** None

**ASSOCIATED DISTRESS TYPE:** None

## **RAVELING - PD0405**

**(Flexible & Composite Pavements)**

### **DEFINITION:**

An area of **Raveling** is one where, in more areas than just the wheel paths, the smooth surface has partially or entirely eroded away, leaving the aggregate in the bituminous mixture exposed and creating a rough surface texture.

**Raveling** may be caused by low asphalt content, mix segregation, or improper placement technique.

### **SURVEY:**

A **Raveling** PD shall be recorded when the condition described in the above definition covers more than 50% of a pavement location's surface area.

Consecutive, uninterrupted pavement locations that are identified as **Raveling** areas shall be combined and recorded as one continuous **Raveling** area.

Note that other observed PDs are to be recorded regardless of the presence of **Raveling**.

**SEVERITY / EXTENT:** None

**ASSOCIATED DISTRESS MATRIX:** None

**ASSOCIATED DISTRESS TYPE:** None



## **FLUSHING - PD0406**

**(Flexible & Composite Pavements)**

### **DEFINITION:**

A **Flushing** area is one where the pavement is noticeably darker due to asphalt cement being squeezed to the top of the pavement mixture and deposited on the surface. It usually occurs in the wheel paths and may appear shiny in the perspective view.

Flushing may result from too high an asphalt content for the mixture's void volume.

### **SURVEY:**

A **Flushing** PD shall be recorded when more than 50% of a pavement location's surface area meets the above definition.

Consecutive, uninterrupted pavement locations that are identified as **Flushing** areas shall be combined and recorded as one continuous **Flushing** area.

Note that other observed PDs are to be recorded regardless of the presence of **Flushing**.

**SEVERITY / EXTENT:** None

**ASSOCIATED DISTRESS MATRIX:** None

**ASSOCIATED DISTRESS TYPE:** None

**PARTIAL WIDTH PATCH (w) - PD 0326**  
**PARTIAL WIDTH PATCH (b) - PD 0327**  
**(All Pavement Types)**

**DEFINITION:**

The **(w)** and **(b)** in the above titles stand for **white patch (concrete)** and **black patch (asphalt)**, respectively.

A **Partial Width Patch** is a repaired section where the original pavement has been removed and replaced.

A **Partial Width Patch** must be narrower than the full-lane width, and can be any length in longitudinal direction.

**SURVEY:**

A **Partial Width Patch** PD shall be recorded when a pavement location meets the conditions defined above, with the following exception:

If there is another PD crossing through the patched area, the patch shall not be recorded as a **Partial Width Patch** but, instead, the distresses located within and around the patch shall be treated as AD of the other PD.

Otherwise, the distresses within a **Partial Width Patch** shall **exclusively** be used to estimate and record its condition (Good, Fair, or Poor).

Consecutive, uninterrupted pavement locations that are identified as **Partial Width Patch** areas having the same condition level (Good, Fair, or Poor) shall be combined and recorded as one continuous **Partial Width Patch** area.

**SEVERITY / EXTENT:**

The extent of a **Partial Width Patch** is the **Transverse Length** (width in the transverse direction across the lane) of the patch itself.

**PARTIAL WITH PATCH (w) - PD 0326**  
**PARTIAL WITH PATCH (b) - PD 0327**  
**(All Pavement Types)**

**SEVERITY / EXTENT: continued**

The pavement condition (**Good**, **Fair**, or **Poor**) of a **Partial Width Patch** shall be rated as follows:

- GOOD:** the patch is unbroken and has less than 3 feet of distresses.  
**FAIR:** the patch is broken into 2 pieces by open cracks or has 3' - 6' of distresses.  
**POOR:** the patch is open or broken into 3 or more pieces by open cracks or has more than 6' of distresses.

**ASSOCIATED DISTRESS MATRIX:** (unspecified yet for internal use)

	CONDITION		
TRANSVERSE LENGTH	GOOD	FAIR	POOR
0 - 2 ft.			
>2 - 4 ft.			
>4 - 6 ft.			
>6 - 8 ft.			
>8 ft.			

**ASSOCIATED DISTRESS TYPE:** None

## **NOT SURVEYED - PD0908**

**(All Pavements)**

### **DEFINITION:**

A pavement section that cannot be surveyed due to construction, detouring, poor images, etc.

### **SURVEY:**

A **NOT SURVEYED** PD shall be recorded for pavement locations meeting the above definition.

Consecutive, uninterrupted pavement locations that are identified as **NOT SURVEYED** areas shall be combined and recorded as one continuous **NOT SURVEYED** area.

Other PDs shall not be recorded in **NOT SURVEYED** areas.

**SEVERITY / EXTENT:** None

**ASSOCIATED DISTRESS MATRIX:** None

**ASSOCIATED DISTRESS TYPE:** None

**NOT-SAMPLED AREA - PD0909**  
**(All Pavements)**

**DEFINITION:**

A pavement section passed over for distress type/severity/extent surveying as part of MDOT's network sampling.

**SURVEY:**

A **NOT-SAMPLED AREA** PD shall be recorded for such pavement locations as specified by MDOT.

Other PDs shall not be recorded at the same mileage location of a **NOT-SAMPLED AREA** PD.

**SEVERITY / EXTENT:** None

**ASSOCIATED DISTRESS MATRIX:** None

**ASSOCIATED DISTRESS TYPE:** None

**NEW PAVEMENT TYPE - PD0809**  
**(All Pavements)**

**DEFINITION:**

An indicator of pavement location where the pavement type changes.

**SURVEY:**

This PD shall be recorded at the milepoint of a pavement type change, as specified by MDOT.

**SEVERITY / EXTENT:** None

**ASSOCIATED DISTRESS MATRIX:** None

**ASSOCIATED DISTRESS TYPE:** None

## **NO DISTRESS - PD0501**

**(All Pavements)**

### **DEFINITION:**

A pavement section that has no observable distress as defined in this manual shall be recorded as a **NO DISTRESS** area.

### **SURVEY:**

A **No Distress** PD shall be recorded at the beginning point of a pavement section meeting the condition stated above.

**SEVERITY / EXTENT:** None

**ASSOCIATED DISTRESS MATRIX:** None

**ASSOCIATED DISTRESS TYPE:** None

**INCOMPATIBLE**  
**PRIMARY DISTRESS RECORDINGS**  
**AT**  
**THE SAME MILE POINT LOCATION**



In addition to the description within this document's previous section of constraints on simultaneous recording of multiple **PDs** at the same location, the following is a listing of **PD** incompatibilities at any given linear referencing mile point (0.001 mile) within the distress survey data.

<b>Subject PD Code</b>	<b>PD Codes That Cannot Be Additionally Recorded At The Same Mile Point Range As Subject PD Code</b>
0103	0106,0110,0112,0113,0208,0209,0227,0228,0229,0230,0231,0232,0326,0341,0342,0343,0344,0345,0346,0402,0403,0501,0908
0104	0106,0110,0112,0113,0208,0209,0227,0228,0229,0230,0231,0232,0326,0341,0342,0343,0344,0345,0346,0402,0403,0501,0908
0106	0103,0104,0106,0110,0112,0113,0114,0201,0202,0203,0204,0205,0234,0235,0341,0342,0343,0344,0345,0346,0405,0406,0501,0908
0110	0103,0104,0106,0112,0113,0208,0209,0234,0235, 0227, 0228, 0229,0230,0231,0232,0341,0342,0343,0344,0345,0346,0402,0403,0501,0908
0112	0103,0104,0106,0110,0113,0114,0201,0202,0203,0204,0205,0234,0235,0341,0342,0343,0344,0345,0346,0405,0406,0501,0908
0113	0103,0104,0106,0110,0112,0114,0201,0202,0203,0204,0205,0234,0235,0341,0342,0343,0344,0345,0346,0405,0406,0501,0908
0114	0106,0112,0113,0208,0209,0227,0228,0229,0230,0231,0232,0326,0341,0342,0343,0344,0345,0346,0402,0403,0501,0908
0201	0106,0112,0113,0201,0208,0209,0227,0228,0229,0230,0231,0232,0326,0341,0342,0343,0344,0345,0346,0402,0403,0501,0908
0202	0106,0112,0113,0202,0208,0209,0227,0228,0229,0230,0231,0232,0326,0341,0342,0343,0344,0345,0346,0402,0403,0501,0908
0203	0106,0112,0113,0203,0208,0209,0227,0228,0229,0230,0231,0232,0326,0341,0342,0343,0344,0345,0346,0402,0403,0501,0908
0204	0106,0112,0113,0204,0208,0209,0234,0227,0228,0229,0230,0231,0232,0326,0341,0342,0343,0344,0345,0346,0402,0403,0501,0908
0205	0106,0112,0113,0205,0208,0209,0235,0227,0228,0229,0230,0231,0232,0326,0341,0342,0343,0344,0345,0346,0402,0403,0501,0908
0208	0103,0104,0110,0114,0201,0202,0203,0204,0205,0208,0234,0235,0341,0342,0343,0344,0345,0346,0405,0406,0501,0908

<b>Subject PD Code</b>	<b>PD Codes That Cannot Be Additionally Recorded At The Same Mile Point Range As Subject PD Code</b>
0209	0103,0104,0110,0114,0201,0202,0203,0204,0205,0209,0234,0235,0341, 0342,0343,0344,0345,0346,0405,0406,0501,0908
0234	0106,0110,0112,0113,0204,0208,0209,0234,0227,0228,0229,0230,0231,0232, 0326,0341,0342,0343,0344,0345,0346,0402,0403,0501,0908
0235	0106,0110,0112,0113,0205,0208,0209,0235,0227,0228,0229,0230,0231,0232, 0326,0341,0342,0343,0344,0345,0346,0402,0403,0501,0908
0227	0103,0104,0110,0114,0201,0202,0203,0204,0205,0234,0235,0227,0230, 0341,0342,0343,0344,0345,0346,0405,0406,0501,0908
0228	0103,0104,0110,0114,0201,0202,0203,0204,0205,0234,0235,0228,0231, 0341,0342,0343,0344,0345,0346,0405,0406,0501,0908
0229	0103,0104,0110,0114,0201,0202,0203,0204,0205,0234,0235,0229,0232, 0341,0342,0343,0344,0345,0346,0405,0406,0501,0908
0230	0103,0104,0110,0114,0201,0202,0203,0204,0205,0234,0235,0227,0230, 0341,0342,0343,0344,0345,0346,0405,0406,0501,0908
0231	0103,0104,0110,0114,0201,0202,0203,0204,0205,0234,0235,0228,0231, 0341,0342,0343,0344,0345,0346,0405,0406,0501,0908
0232	0103,0104,0110,0114,0201,0202,0203,0204,0205,0234,0235,0229,0232, 0341,0342,0343,0344,0345,0346,0405,0406,0501,0908
0326	0103,0104,0114,0201,0202,0203,0204,0205,0234,0235,0326,0327,0341, 0342,0343,0344,0345,0346,0405,0406,0501,0908
0327	0326,0327,0341,0342,0343,0344,0345,0346,0501,0908
0341	0103,0104,0106,0110,0112,0113,0114,0201,0202,0203,0204,0205,0208,0209,0234, 0235,0227,0228,0229,0230,0231,0232,0326, 0327,0341,0342,0344,0345, 0346,0405,0406,0501,0908
0342	0103,0104,0106,0110,0112,0113,0114,0201,0202,0203,0204,0205,0208,0209,0234, 0235,0227,0228,0229,0230,0231,0232,0326,0327,0341,0342,0343,0344, 0345,0346,0402,0403,0405,0406,0501,0908
0343	0103,0104,0106,0110,0112,0113,0114,0201,0202,0203,0204,0205,0208,0209,0234, 0235,0227,0228,0229,0230,0231,0232,0326,0327,0342,0343,0344,0345, 0346,0405,0406,0501,0908
0344	0103,0104,0106,0110,0112,0113,0114,0201,0202,0203,0204,0205,0208,0209,0234, 0235,0227,0228,0229,0230,0231,0232,0326,0327,0341,0342,0343,0344, 0345,0346,0402,0403,0405,0406,0501,0908

<b>Subject PD Code</b>	<b>PD Codes That Cannot Be Additionally Recorded At The Same Mile Point Range As Subject PD Code</b>
0345	0103,0104,0106,0110,0112,0113,0114,0201,0202,0203,0204,0205,0208,0209,0234, 0235,0227,0228,0229,0230,0231,0232, 0326,0327,0341,0342,0343,0344, 0345,0346,0402,0403,0405,0406,0501,0908
0346	0103,0104,0106,0110,0112,0113,0114,0201,0202,0203,0204,0205,0208,0209,0234, 0235,0227,0228,0229,0230,0231,0232,0326,0327,0341,0342,0343,0344, 0345,0346,0402,0403,0405,0406,0501,0908
0402	0103,0104,0110,0114,0201,0202,0203,0204,0205,0234,0235,0342,0344, 0345,0346,0402,0405,0406,0501,0908
0403	0103,0104,0110,0114,0201,0202,0203,0204,0205,0234,0235,0342,0344, 0345,0346,0403,0405,0406,0501,0908
0405	0106,0112,0113,0208,0209,0227,0228,0229,0230,0231,0232,0326,0341,0342,0343, 0344,0345,0346,0402,0403,0405,0406,0501,0908
0406	0106,0112,0113,0208,0209,0227,0228,0229,0230,0231,0232,0326,0341,0342,0343, 0344,0345,0346,0402,0403,0405,0406,0501,0908
0501	0103,0104,0106,0110,0112,0113,0114,0201,0202,0203,0204,0205,0208,0209,0234, 0235,0227,0228,0229,0230,0231,0232,0326,0327,0341,0342,0343,0344, 0345,0346,0402,0403,0405,0406,0501,0908
0809	0809
0908	0103,0104,0106,0110,0112,0113,0114,0201,0202,0203,0204,0205,0208,0209,0234, 0235,0227,0228,0229,0230,0231,0232,0326,0327,0341,0342, 0343,0344, 0345,0346,0402,0403,0405,0406,0501,0908
0909	0103,0104,0106,0110,0112,0113,0114,0201,0202,0203,0204,0205,0208,0209,0234, 0235,0227,0228,0229,0230,0231,0232,0326,0327,0341,0342, 0343,0344, 0345,0346,0402,0403,0405,0406,0501,0908, 0909

**FORMAT LAYOUT OF  
CONDITION - SPECIFIC DATA  
WITHIN A DISTRESS SURVEY FILE**

The format of records in a detailed distress condition data file is defined in the MDOT document **FILE FORMATS OF LOCATION REFERENCING, DISTRESS, AND SENSOR DATA** (ATTACHMENT F). Each record has 14 data fields that are separated by commas. This section is devoted to providing the exact layout of the following portion (Data Fields 9 -14) of a distress condition data record for each **PD**:

**PD\_Code (4 characters, including a leading zero):**

Code of a principal distress condition.

**AD1\_SL\_Index**

**AD2\_SL\_Index (2 characters max each):**

Indices of severity level of **AD (Associated Distress)**

These two indices define severity and/or extent of a principal distress condition based on the corresponding Associated Distress matrix .

**AD\_Type\_Index (2 characters max) :**

This is the index of the associated distress type.

**FID\_RECORD\_START (6 characters max):**

Frame ID of the beginning video image used to define pavement distress condition in this record.

**FID\_RECORD\_END (6 characters max):**

Frame ID of the ending video image used to define pavement distress condition in this record.

The Vendor's surveyor shall move video images so that the beginning point of a PD or AD of a **PD** is as close as possible to the bottom edge of the survey screen. The **FID\_RECORD\_START** for the **PD**, then, is the **Frame ID** of the survey image shown on the survey screen at that location. The **FID\_RECORD\_END** for the **PD** depends on the PD's characteristics as described below:

(1) Transverse-oriented PDs such as Transverse Crack:

For this type of PD, **FID\_RECORD\_START** and **FID\_RECORD\_END** shall be the same **Frame ID**.

(2) Longitudinal-oriented PDs such as Longitudinal Crack:

For this type of PD, **FID\_RECORD\_END** shall be the **Frame ID** of the first video image that does not display the PD being recorded.

Data fields 9 - 14 in a distress condition data record shall be of the following form:

<PD\_Code>, <AD1\_SL\_Index>, <AD2\_SL\_Index>, <AD\_Type\_Index>,

<FID\_RECORD\_START>, <FID\_RECORD\_END>

The exact data layouts of the above portion of a distress condition data record for all **PDs** are provided below:

**(1) TRANSVERSE JOINT - PD0106**

0106, <1-5>, <1-5>, <1-8>, <FID\_RECORD\_START>, <FID\_RECORD\_END>

**(2) TRANSVERSE TEAR - PD0114**

0114, -1, -1, -1, <FID\_RECORD\_START>, <FID\_RECORD\_END>

**(3) TC - PD0113 for Rigid & CRC Pavements**

113, <1-8>, <1-5>, <1-8>, <FID\_RECORD\_START>, <FID\_RECORD\_END>

**(4) TC - PD0110 for Composite Pavements**

110, <1-8>, <1-5>, -1, <FID\_RECORD\_START>, <FID\_RECORD\_END>

**(5) TC (straight ) - PD0103**

103, <1-8>, <1-4>, -1, <FID\_RECORD\_START>, <FID\_RECORD\_END>

**(6) TC (irregular) - PD0104**

104, <1-8>, <1-4>, -1, <FID\_RECORD\_START>, <FID\_RECORD\_END>

**(7) TC (open > 1/4 in.) - PD0112**

112, <1-8>, <1-5>, <1-8>, <FID\_RECORD\_START>, <FID\_RECORD\_END>

**(8) L. JOINT (right) - PD0209 , L. JOINT (left ) - PD0208**

<209 or 208>, <1-4>, -1, <1-8>, <FID\_RECORD\_START>, <FID\_RECORD\_END>

**(10) LC (right WP) - PD0230 , LC (center of lane) - PD0231,  
LC (left WP) - PD0232 , LC >1/4 in. (right WP ) - PD0227,  
LC >1/4 in. (C. of lane) - PD0228 , LC >1/4 in. (left WP ) - PD0229**

<227-232>, <1-7>, -1, <1-8>, <FID\_RECORD\_START>, <FID\_RECORD\_END>

**(11) LC (left edge ) - PD0201 , LC (left WP ) - PD0205,  
LC (center of lane) - PD0202 , LC (right WP) - PD0204,**

**LC (right edge ) - PD0203**

<201-205>, <1-7>, -1, -1, <FID\_RECORD\_START>, <FID\_RECORD\_END>

**(12) ALLIGATOR CRACKING (right WP or left WP) - PD0234 or PD0235**

<234 or 235>, <1-5>, -1, -1, <FID\_RECORD\_START>, <FID\_RECORD\_END>

**(13) DELAMINATED AREA - PD0341 , MAP CRACKING - PD0342,  
HIGH STEEL - PD0343**

<341-343>, <1-5>, -1, -1, <FID\_RECORD\_START>, <FID\_RECORD\_END>

**(14) SHATTERED AREA - PD0344**

344, -1, -1, <1-2>, <FID\_RECORD\_START>, <FID\_RECORD\_END>

**(15) BLOCK CRACKING - PD0345**

345, -1, -1, -1, <FID\_RECORD\_START>, <FID\_RECORD\_END>

**(16) REFL. SHATTERED AREA - PD0346**

346, -1, -1, -1, <FID\_RECORD\_START>, <FID\_RECORD\_END>

**(17) POPOUTS - PD0402**

402, -1, -1, -1, <FID\_RECORD\_START>, <FID\_RECORD\_END>

**(18) SCALING - PD0403**

403, -1, -1, -1, <FID\_RECORD\_START>, <FID\_RECORD\_END>

**(19) RAVELING - PD0405**

405, -1, -1, -1, <FID\_RECORD\_START>, <FID\_RECORD\_END>

**(20) FLUSHING - PD0406**

406, -1, -1, -1, <FID\_RECORD\_START>, <FID\_RECORD\_END>

**(21) PARTIAL WIDTH PATCH (w) - PD0326  
PARTIAL WIDTH PATCH (b) - PD0327**

<326 or 327>, <1-5>, <1-3>, -1, <FID\_RECORD\_START>, <FID\_RECORD\_END>

- (22) **NOT SURVEYED - PD0908**  
**NOT-SAMPLED AREA – PD0909**  
**NEW PAVEMENT TYPE - PD0809**  
**NO-DISTRESS AREA - PD0501**

<908 or 909 or 809 or 501>, -1, -1, -1, <FID\_RECORD\_START>, <FID\_RECORD\_END>



## **ATTACHMENT H**

### **Pavement Condition Data/Right-of-Way Image Collection and Processing**

**Years 2012 - 2015**

#### **DISTRESS SURVEY CALL SAMPLING, TESTING, & ACCEPTANCE CRITERIA**

*(Note: This document solely describes MDOT's procedure for review and acceptance of distress survey call quality. Other MDOT checks on the same vendor distress survey data files - automated checking of file format / location referencing / entry logic – are separate procedures and have separate acceptance rules of their own.)*

##### **Definition of Lot and Sample Unit:**

A single lot will be comprised of a single distress survey data file corresponding to a single record listed within the MDOT-provided TapeLog file and identified for distress survey data.

A single sample unit will be comprised of a single Primary Distress/Associated Distress (PD/AD) call recorded within a distress survey data file (lot).

##### **Lot Sampling Method:**

A variation of a systematic sampling procedure with a random start will be utilized.

Selection of sample units from a lot will be based on randomly located segments (sample sub-sections). There will be one sub-section per each mile, with a minimum length equal to 0.5% (26.4 feet).

Step 1 - A random milepoint within the first mile of the data file will be generated to determine the start of the first sample sub-section.

Step 2 - Subsequent sample sub-sections will be located by successively adding 1.0 miles to the initial randomly generated milepoint.

NOTE: MDOT Selection of Distress Survey Data Pay Item Option F2 may require minor modification of the 1.0-mile skipping procedure described above – in order to ensure mileage ranges where the Vendor has actually performed surveying are exclusively chosen for data acceptance sampling/scoring.

The entire lot sample will consist of the sum of sample units (PD/AD calls) contained within the file's randomly selected sub-sections.

##### **Lot Testing Method:**

All PD/AD calls located within each sample sub-section will be individually verified for accuracy by an MDOT QA Officer who will simultaneously view the vendor's provided pavement imaging.

**Correct PD/AD Call** - Both the PD and AD are properly recorded in the data.

Incorrect PD/AD Call – Any of the following:

1. A PD call is not recorded in the data.
2. A PD call is incorrectly recorded in the data as another PD.
3. A PD call is correctly recorded, but AD call is incorrectly recorded.

The PD call “No Distress” is the correct call for pavement imaging where no distress exists.

Computation of Lot Quality Level:

MDOT QA Officer verification results from all sub-sections will be used to estimate lot quality level (QL) based on the following equations:

Variables:

N	=	No. of PD/AD Calls Made by MDOT QA Officer
K	=	No. of PD/AD Calls Made by Vendor Surveyor
M	=	No. of Correct PD/AD Calls Made by Vendor Surveyor
QL	=	Estimated Quality Level of Lot

Quality Level Equations:

If $K \leq N$ ,	$QL = (M / N) \times 100\%$
If $K > N$ ,	$QL = [(M - (K - N)) / N] \times 100\%$

Lot Acceptance/Rejection Decision Rules:

A single lot's distress survey quality will be accepted when QL meets the following criteria:

For $K > 20$ ,	$QL \geq 85\%$
For $15 < K \leq 20$ ,	$QL \geq 84\%$
For $10 < K \leq 15$ ,	$QL \geq 83\%$
For $5 < K \leq 10$ ,	$QL \geq 82\%$
For $1 \leq K \leq 5$ ,	$QL \geq 81\%$

Rejected lots shall be corrected and re-submitted as described in Section B.2.6 of this Scope of Work.

## **APPENDIX**

### DEFINITIONS

The following definitions are used throughout the Scope:

MDOT means Michigan Department of Transportation

File(s) means electronic data files.

Vendor means party awarded the contract.

State means State of Michigan.

FHWA means Federal Highway Administration

AASHTO means American Association of State Highway and Transportation Officials

QA means (MDOT) Quality Assurance